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Wheat Trade Flows and Logistical Competition from the United States and Black Sea Origins to Targeted International Markets

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Abstract: The Russia-Ukraine war has drastically affected international grain marketing. Most important are 1) shipments through traditional Black Sea routes, which are now subject to capacity constraints, are riskier due to the war, and face higher ocean shipping costs partly as a result of the conflict; and 2) the development of new ports in the Baltic Sea. Additionally, the international marketing system has transitioned from a highly competitive spatial market to one that the Russian government controls more extensively. The Russian government has maintained a long-term policy of export quotas and minimum export prices, while recently announcing the designation of friendly countries, which are targeted for more favorable trade terms. In contrast, other countries are labeled as 'unfriendly' and face trade restrictions. This project aims to develop a model of export logistics and trade flows for wheat, evaluating the potential impacts of changes in the export regime in the Black Sea region. The model was designed to determine the most efficient trade flows and routes between export ports and importing regions and countries.

Results reflect the spatial competition in the global wheat market. The United States' key markets include Asia, South America, and Mexico. Major competitors in these regions are Australia and Argentina. Russia's competitive advantage lies with Turkey and other Middle Eastern countries, as well as North Africa (including Egypt). Russia also competes with the United States in Mexico and maintains a presence in Southeast Asia.

Two sets of results are crucial to logistics competition. First, for most ports, capacity is sufficient. However, capacity is limited at the Russian and Ukrainian ports. Key variables in this model that show seasonal patterns include import demand, export supply, basis, and ocean freight rates. These variables lead to seasonal logistical demand specifications for exports. The findings indicate that the United States would experience peaks from April to September; Australia from January to June; Argentina in December; the EU in March to April and again in August to September; Ukraine from August to November; and Russia from August to December.

Several sensitivities were evaluated to assess their impact on logistical functions. Sensitivity analysis indicates that: 1) expanding port infrastructure in Russia competes with shipments from the United States; 2) relaxing the Russian export quotas alters the seasonality of wheat shipments from Russia and other countries; 3) removing the "unfriendly country" designation from Russia leads to a slight increase in Russian shipments to Southeast Asia but little impact elsewhere; 4) strict enforcement of the Russian minimum price strategy results in increased shipments from the United States and other exporting countries; and 5) expanding exports from Russia by 20% over 2 years (compared to 50% over 5 years as planned) results in an expansion of Russian exports, negatively impacting exports from the United States, Argentina, and Australia, and would necessitate a significant growth in new import markets to accommodate these changes.

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Introduction

Significant changes have been occurring in the world grain trade. Several factors have contributed to these changes, including government intervention policies and supply chain problems. These are in addition to the significant impact of the Russia–Ukraine war, which began in 2022.[1] Previous studies[2] Illustrated that logistics costs and functions 1) impact export competitiveness and 2) are associated with increased risks. In addition to numerous interventions and disruptions, the Russia-Ukraine war has led to changes in the routes and costs of grain exports from these regions. These changes in logistics costs and functions have a significant impact on US exports and pose challenges to the US logistics system for grain trade.

These changes are significant for wheat. Before the 1990s, the United States was the dominant supplier of wheat to the global market, and its logistical system facilitated its dominance. However, the US market share (measured as the value of wheat exports) decreased from 40% in 2000 to 12% in 2021. Competition has intensified, and Russia has increased its dominance as a major wheat exporter in global markets.

There are several important reasons for this increased competition. One is the proximity of Black Sea ports to the EU, the Middle East, and African markets. Secondly, the market penetration of Black Sea exporters into markets such as Mexico and South America, as well as shipments from Poland to the United States (Florida and New York), and several Asian markets. Third, despite global wheat trade being competitive and transparent in the early 2000s, it has seen an escalation of interventions (export taxes, quotas, etc.), causing increased volatility in world wheat markets and trade.

Important changes to the Russian grain trading system began before February 2022. These include the imposition of export taxes and quotas, increased concentration of Russian grain trading firms, and the creation of new ports and routes. The Russia-Ukraine war has also had unique impacts on wheat exports. Most important are: 1) the negative impact on Ukrainian domestic production, the removal of export restrictions, and the creation of alternative routes for Ukrainian grain exports such as the "Grain Corridor"; 2) the imposition of sanctions (though not imposed on food exports) and designation of friendly and unfriendly countries in trade; 3) development of new routes in part to avoid sanctions (Bloomberg, 2022) such as overland shipments to China[3]; and 4) the implementation of restrictions by Russia on Western exporting

[1] For consistency, we use the term Russia-Ukraine war, which began in February 2022.

[2] As described in Bullock, Lakkakula and Wilson (2023), Kamrud, Wilson, and Bullock (2023), Wilson Lakkakula and Bullock (2021; 2024), among others.

[3] Apparently, China has agreed to allow imports from Russia and discussions of quality/specifications are one of the priority topics in discussion in early 2023. Given China is one of the largest wheat importers, and Russia the largest wheat exporter, these developments are important, though there has been very limited trade between Russia and China.

firms to exit the Russian trade, which results in less transparency in pricing. Lower exportable supplies from the United States also compound these issues.

The changes described above have led to significant shifts in international trade and have the potential to impact wheat exports more than other grains, given Russia's dominance in the global wheat trade. This project aims to develop a model of export logistics and trade flows for wheat, evaluating the potential impacts of changes in the export regime in the Black Sea region. Background information and previous studies are described in the next section.

The empirical model employed in this study possesses several key features. It is a minimum-cost network flow model of the world wheat trade. The focus is on wheat competitiveness that grows in the Black Sea. The model includes US wheat exports (specifically, HRW and SRW) and wheat exports from the EU, Argentina, and Australia. The model analyzes shipments to the significant importing regions and countries from these exporting countries. The model uses monthly data because most critical variables are seasonal, which impacts the results. These include seasonality of the FOB basis (Free-on-Board), export supplies and capacities, and import demands. Costs are based on the FOB (Free on Board) basis and include ocean shipping costs. Important policy variables affecting logistics are also included (and described below). Most variables are risky (stochastic in their specification) and treated as random distributions in the empirical model. These include basis, shipping costs, import demands, export supplies, and capacity constraints. The empirical model is similar to previous studies on soybean trade (Kamrud, Wilson, and Bullock, 2023; Wilson & Bullock, 2024) and corn trade (Bullock, Lakkakula, and Wilson, 2023; Wilson, Lakkakula, and Bullock, 2021 and 2024). Ultimately, the goal is to determine the impact of these factors on the distribution of exports from the US logistical system.

Background and Previous Studies

World Wheat Trade and Major Import Markets for Russian Wheat:[4]

The world wheat trade has evolved over the past few decades. Export market shares for world wheat are shown in Figure 1. The United States was the dominant supplier from the 1990s until about 2013/14. At that time, the European Union (EU) was the largest wheat exporter, surpassing the United States. By 2014/15, Russia's wheat exports surpassed those of the United States, and from 2016/17 to the present, Russia has been the largest exporter.

[4] Reidy (2024) provides a recent overview of the Russian grain market economy.

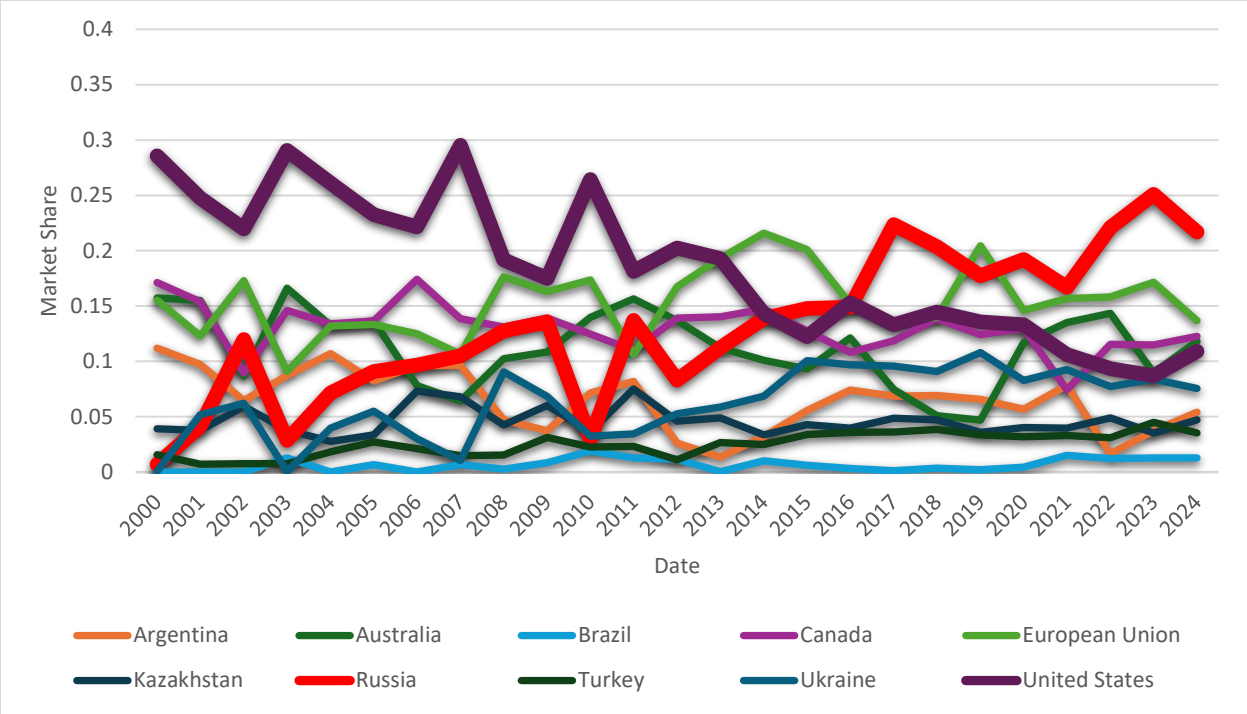

Figure 1. Market Shares for Major World Wheat Exporters

Source: Fastmarkets

Figures 2 and 3 show the major importers of Russian wheat. Results show that Egypt and Turkey are the dominant importers, followed by Bangladesh, Sudan, etc. Most of these imports are in Africa and the Middle East. However, in recent years, there have been increased shipments to Indonesia, Mexico, and other countries that are typically importers of US wheat.

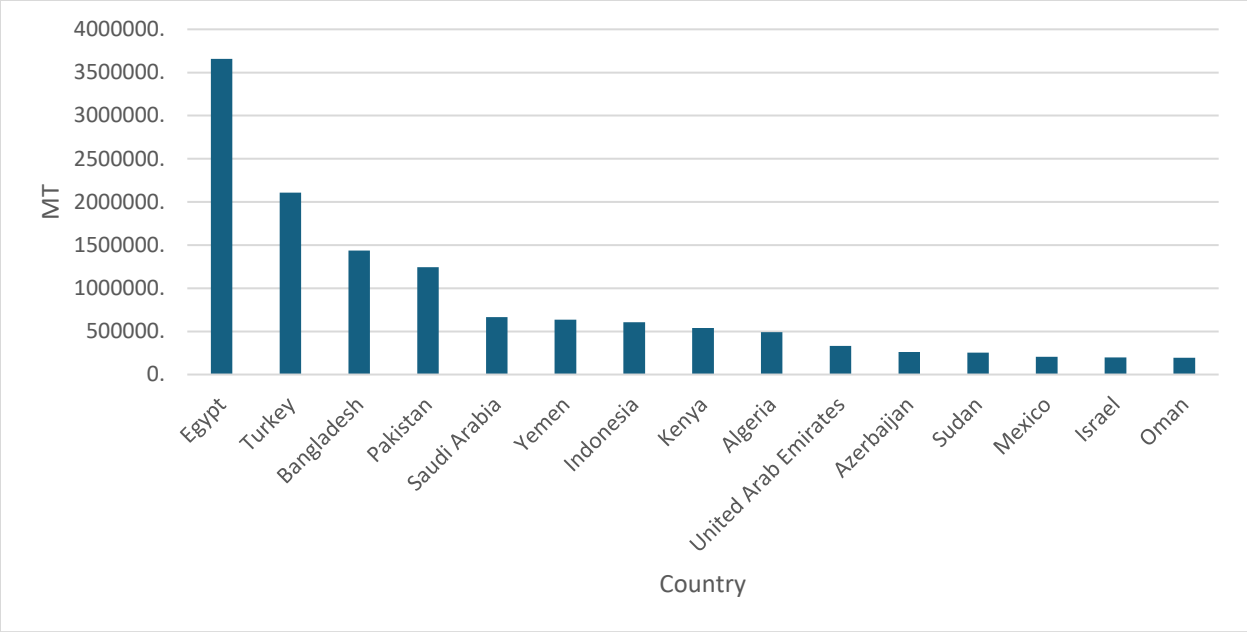

Figure 2. Russia Top 10 Importers (2024)
Source: Fastmarkets

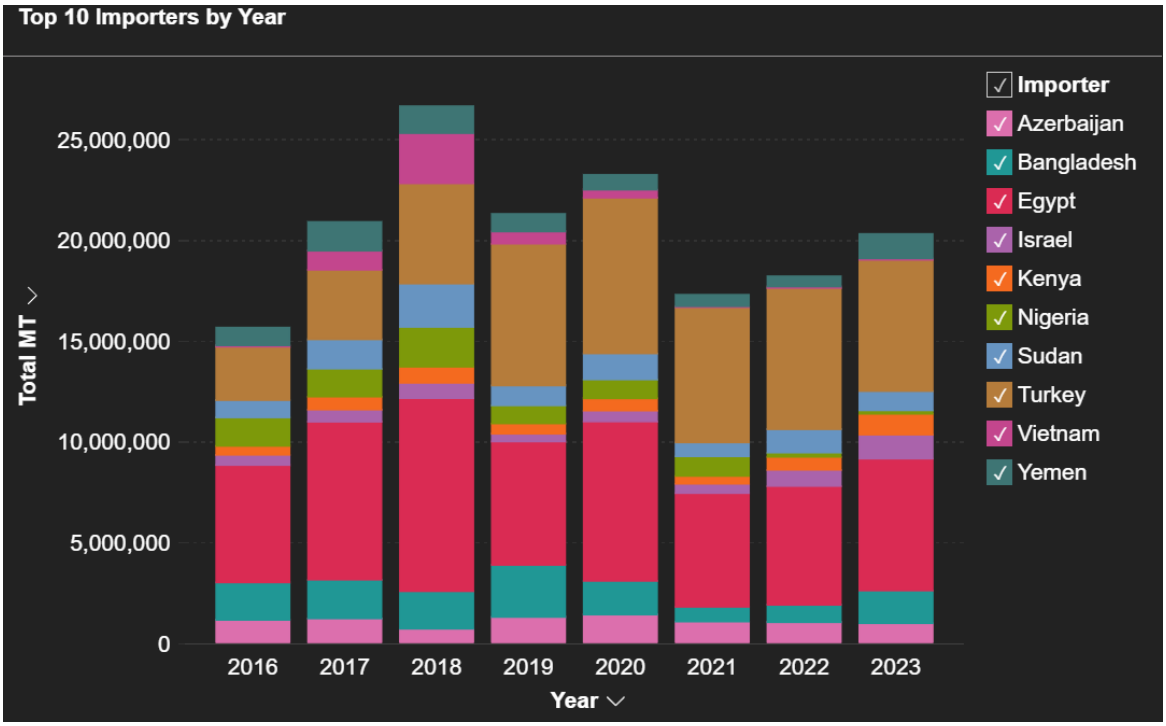

Figure 3. Russia Wheat Exports by Import Country, 2016-2023
Source: Fastmarkets

Export Prices and Ocean Shipping Costs:

The world wheat market is highly competitive, resulting in highly correlated prices. Export FOB prices (Fastmarkets) from the major exporters are shown in Figure 4. These data illustrate that 1) these prices are highly correlated, 2) there has been a radical price escalation following the Russia-Ukraine war and increased risks in Black Sea shipping, and 3) FOB export prices have fallen since the start of the war. Generally, prior to February 2022, the differences were relatively minor. However, following February 2022, the differences among origins increased.

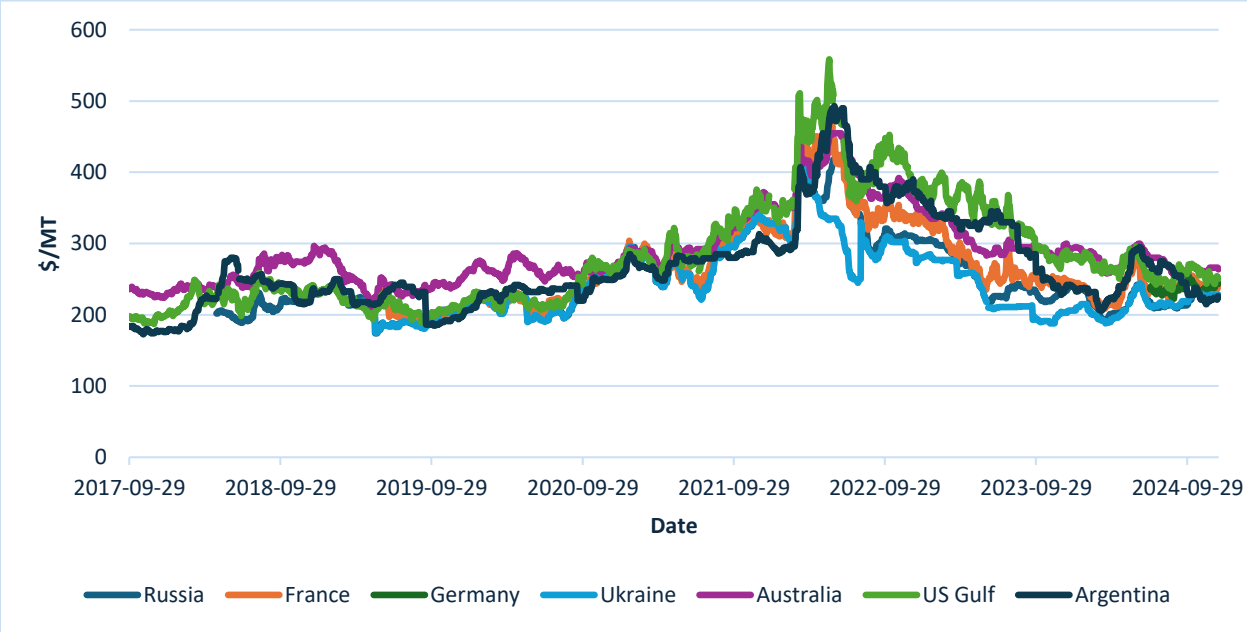

Figure 4. FOB Export Prices for Major Wheat Exporters

Source: Reuters and Fastmarkets

Table 1 shows the price differences relative to Russia, Novorossiysk (commonly referred to as Novo). The results are summarized as the average from September 2017 to February 2022 and the period following the onset of the war from March 2022 to October 2024. The results are important to international competitiveness.

Table 1. Comparison of Export FOB Prices to Novorossiysk Prices, Pre- and Post-February 2022

	International Prices				US Prices		Black Sea/Baltic Prices						Futures Price $/mt			
	France	Argentina	Argentina I	Australia	Gulf	PNW	Germany	Novo	UKRF	Russia F	Poland	Baltic	CME	KC	MGEX	Euronext
$ Greater than Novo																
Average for the period:																
2017 to 2022 (February)	-5	14	43	12	33	40	25	0	15	20	20	21	-25	-35	5	0
2022 (March) to 2024 (October)	39	119	55	50	81	85	45	0	-18	9	28	28	-7	22	36	43

Source: Reuters Eikon and Fastmarkets (for Ukraine-F)

The data show the price difference in a specific origin compared to Novorossiysk. First, during the period prior to February 2022, price differentials were relatively small. Notably, France's price was lower than the Novorossiysk price. Argentina's and Australia's prices were approximately $12-14 higher than Novorossiysk's, and US prices had a more significant premium than their competitors. Ukraine had a premium to Russia and Poland within the Black Sea region, but the Baltic was about equal to Novorossiysk. Following February 2022, these values changed for all exporters except Ukraine, with the FOB price premium increasing relative to Novorossiysk. The Ukraine FOB price fell relative to Novorossiysk.[5]

Ocean shipping costs for the significant wheat shipping routes were collected from Eikon.[6] These are monthly data for Panamax shipments. and reflect the shipment size for the predominant movement, as in Eikon. For illustration, Figures 5 to 10 illustrate the movement in ocean rates from the primary exporting origins to the significant destinations from 2018 to 2024. Results indicate that rates are highly competitive and highly correlated. Periodic spikes began in 2021 but were exceptionally high during the period following February 2022. There are numerous reasons for this spike, including an increase in fuel costs, war premiums for shipments from certain Black Sea origins, and the reluctance of some shipowners to allow their vessels to enter the Black Sea, as well as unexpected wait times for vessel loading, among other factors.

Shipping costs in this market evolved following the commencement of the Black Sea Grain Initiative in July 2022, which reduced the risks associated with shipping through the Black Sea, to Russia's withdrawal from the agreement, and Ukraine's development of the Grains from Ukraine strategy.[7] In the March 2025 attempts at a cease-fire negotiation, Russia demanded the reinvigoration of the original Black Sea Grain Initiative, including access to SWIFT and the facilitation of Russian grain and fertilizer exports. At least initially (as of late March 2025), there were no favorable changes in risks for shipping on the Black Sea (Belikova & Hughes, 2025). The data illustrate the competition and correlation among ocean rates on different routes. The figures also illustrate the volatility in the ocean shipping industry, which was exacerbated during and after February 2022, as well as by oil prices. For most routes, there was greater volatility in shipping costs, which began in about 2021. This was likely due to the increase in oil prices that began in 2021. There was also a spike, which varied across origins in 2022, partly due to the Russia-Ukraine war and underlying risks, as well as war insurance. Since then, ocean rates have declined but remain volatile.

[5] A Russian commodity analyst suggested that, in general, Baltic states' prices are at a slight discount to Black Sea prices prior to the onset of the Russia–Ukraine war. After that, shipments from both Novorossiysk and Ukraine faced military risks and high premiums for war insurance. Furthermore, some vessels were reluctant to enter Black Sea Russian ports, resulting in a discount for the Black Sea ports compared to the Baltic. Some vessels did not want to serve Kaliningrad, so the latter was at a FOB discount to the neighboring Baltic states' ports. In addition, Kaliningrad could only be allowed to ship handysize vessels. Cumulatively, these range from $2-5/mt.

[6] EIKON is the data platform of REFINITIV, formerly Thompson-Reuters.

[7] These developments are described in detail in Wilson and Bullock (2025).

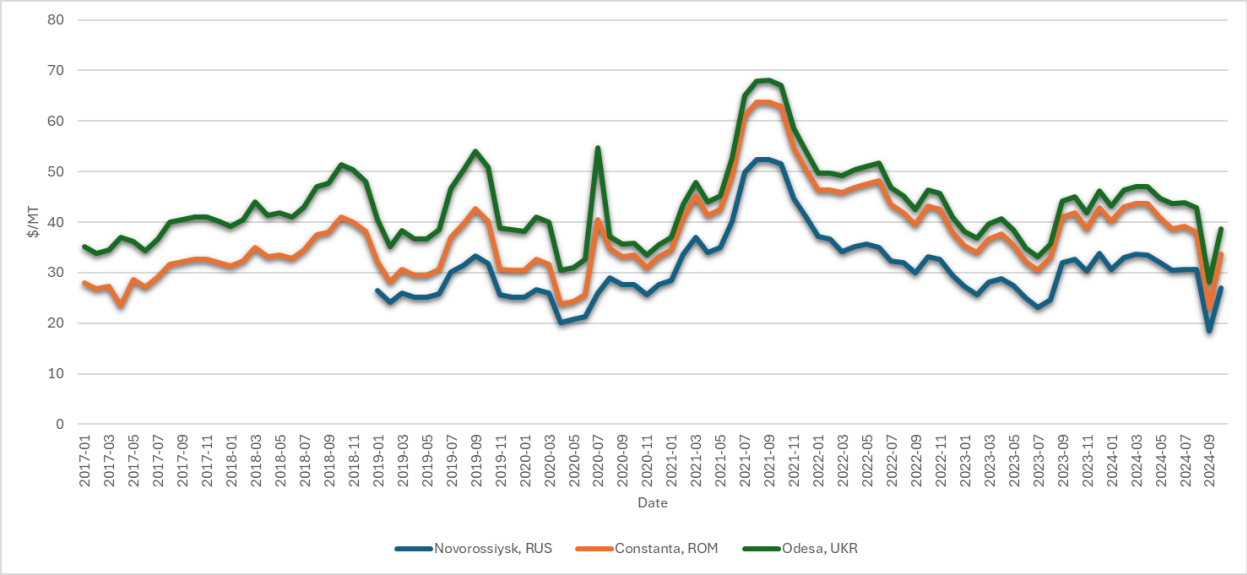

Figure 5. Ocean Rates from the Black Sea to China

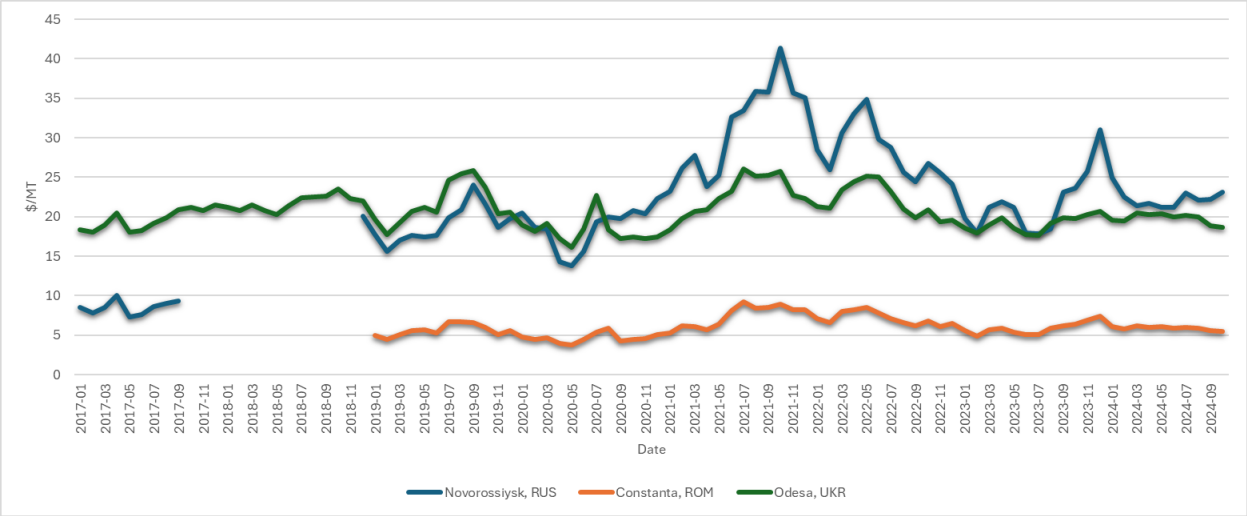

Figure 6. Ocean Rates from the Black Sea to Egypt

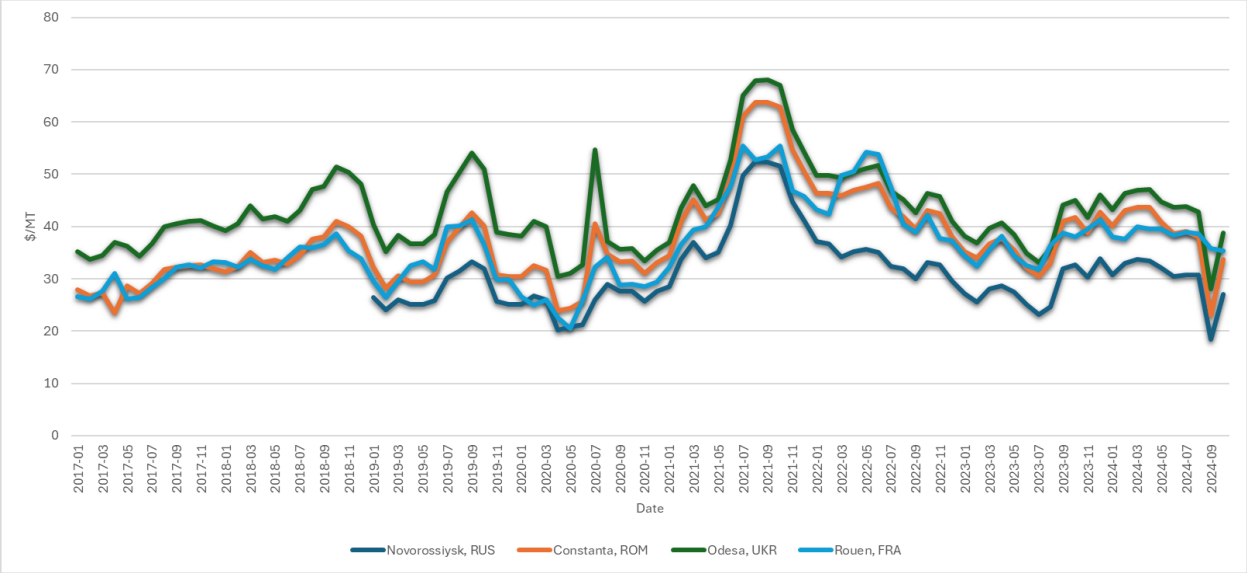

Figure 7. Ocean Rates from Europe to China

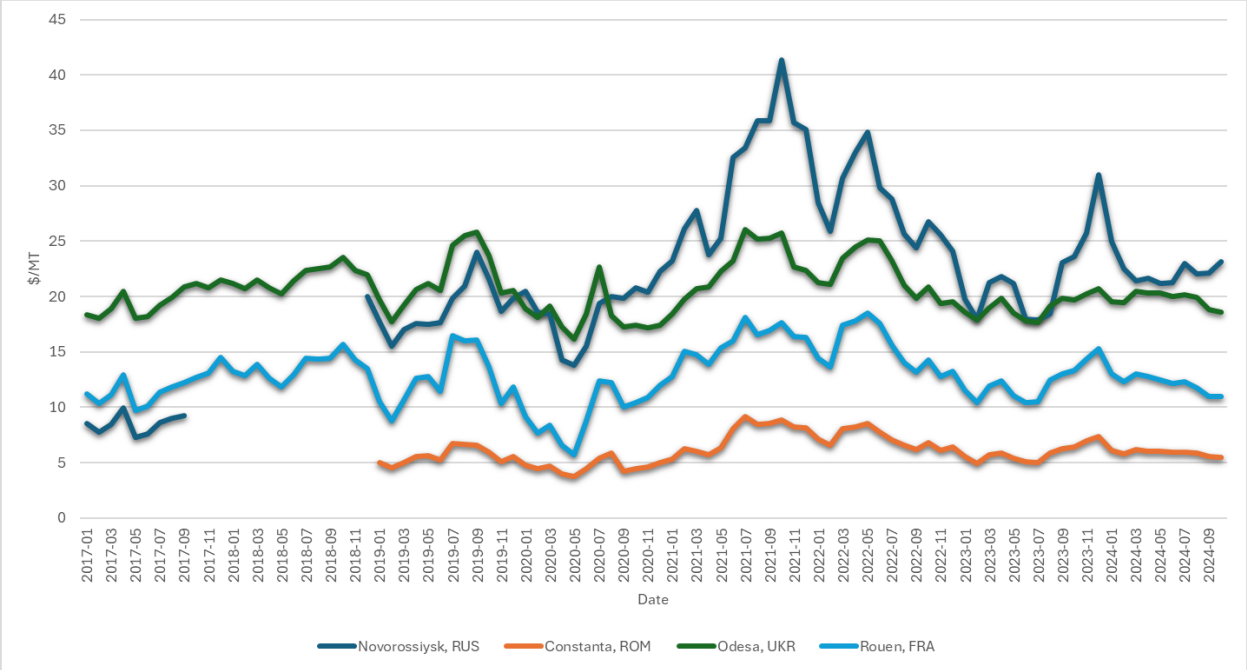

Figure 8. Ocean Rates from Europe to Egypt

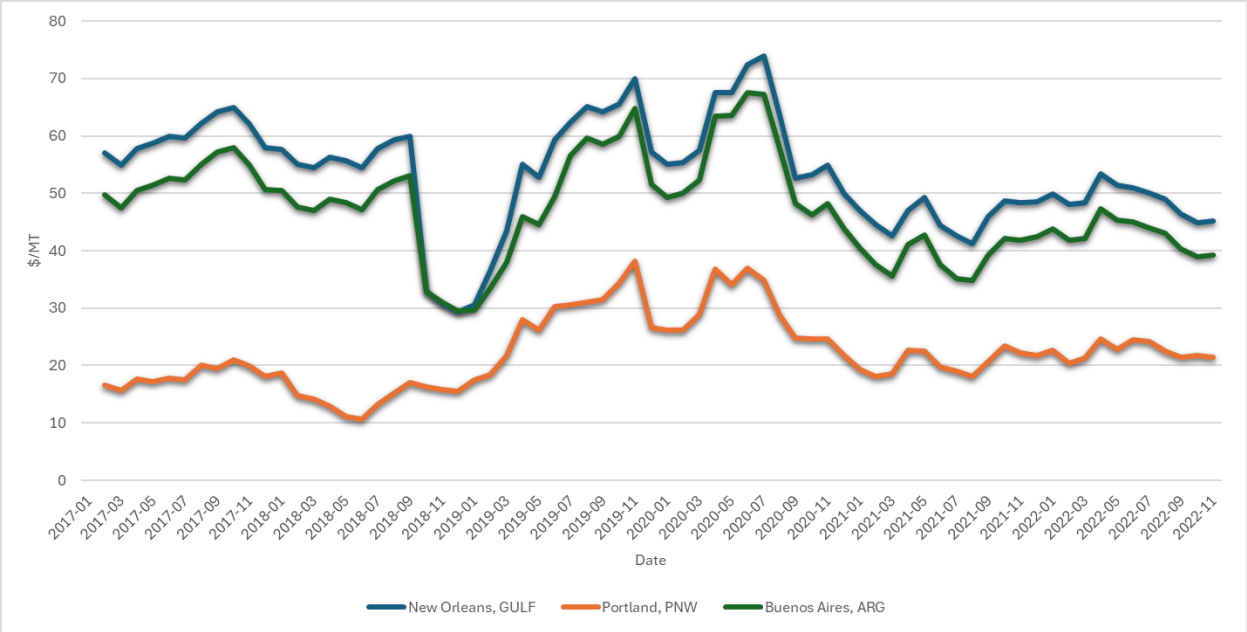

Figure 9. Ocean Rates from the US and Argentina to China

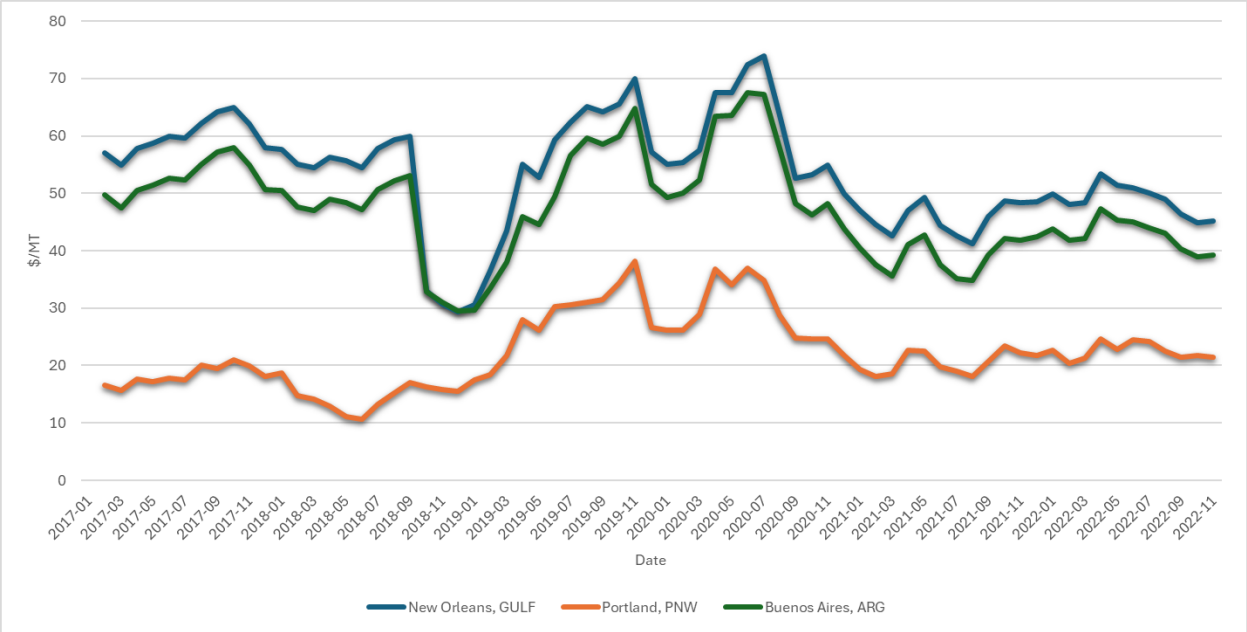

Figure 10. Ocean Rates from the US and Argentina to Egypt

Crucial to the analysis of logistics competition is how ocean shipping costs change in this case, before and after February 2022, and relative to Novorossiysk. These are derived from the data above and shown below for shipments to Egypt and China from each exporting origin port that is important in this study. Results were somewhat mixed regarding the changes that occurred before and after February 2022. Rates for shipments to Egypt increased from the US

Gulf, EU, Constanta, and Novorossiysk; from other origins decreased. Rates for shipment to China increased from PNW, EU, and Constanta; all others decreased.

Important to this study are changes that occur relative to shipping from Novorossiysk. The bottom panel of Table 2 shows how rates change from other exporting origins compared to Novorossiysk for shipments to Egypt and China, both before and after February 2022. Results indicate that 8 of the 12 routes gained an advantage relative to Novorossiysk. The most significant absolute change was Argentina to China, followed by the U.S. Gulf to China, PNW to Egypt, and then Argentina to Egypt. Four exporting origins lost an advantage relative to Novorossiysk. The most significant relative losses occurred from PNW, EU, and Constanta shipments to China. For each of these, the changes resulted in an increased advantage for Novorossiysk.

Table 2. Changes in Ocean Shipping Rates Pre- and Post-February 2022, and Relative to Novorossiysk

Origin Port Area	USG		PNW		ARG		EU (Rouen)		Odessa		Constanta		Black Sea (Novo)	
Destination	**Egypt**	**China**	**Egypt**	**China**	**Egypt**	**China**	**Egypt**	**China**	**Egypt**	**China**	**Egypt**	**China**	**Egypt**	**China**
Total Cost ($US per MT)														
2019 to Feb 2022	20.11	55.08	43.88	20.83	30.52	49.01	12.72	35.89	20.86	44.76	5.95	38.92	23.21	31.78
Mar 2022 to Oct 2024	22.58	51.34	40.84	23.77	27.56	45.23	13.21	39.60	20.26	42.82	6.28	39.37	23.96	30.27
Change in Rates	2.47	-3.74	-3.04	2.94	-2.96	-3.78	0.49	3.72	-0.60	-1.94	0.33	0.45	0.74	-1.51
Over Novo ($US per MT)														
2019 to Feb 2022	-3.10	23.29	20.67	-10.95	7.31	17.23	-10.49	4.11	-2.36	12.98	-17.26	7.14		
Mar 2022 to Oct 2024	-1.38	21.07	16.88	-6.50	3.60	14.97	-10.74	9.33	-3.69	12.55	-17.68	9.10		
Increase vs Novo	1.73	-2.22	-3.79	4.45	-3.71	-2.26	-0.25	5.23	-1.34	-0.42	-0.41	1.97		
Gain in Advantage	loss	gain	gain	loss	gain	gain	gain	loss	gain	gain	gain	loss		

Russian Export Logistics and Port Capacities and Expansions:

The Russian grain marketing system has undergone a series of transitions since the 1990s, if not earlier. The market structure of grain export firms has changed (described below). In addition, the rail network has deteriorated, partly due to sanctions (van Buren, 2024), and the rail structure is not competitive (Belikova, 2024). Most railcars are controlled by one company, and the carriers selectively apply allowances (discounts to tariffs)[8] to induce or discourage shipments on specific routes.

This study focuses on export logistics, including international shipping costs (as discussed above), and port or route capacity. The principal port for wheat exports is Novo in the Black Sea. Other ports in the Black Sea include Tuapse, Taman, Port Kavkaz, and Rostov. These are summarized in Table 3. Belikova (2024) indicated four deep-sea Black Sea ports, and Demetra Trading Company owns 100% of Novorossiysk grain, 35% of Novorossiysk Khlboproduct, and 50% of Taman. Figure 11 illustrates the Black Sea ports, and Figure 12 shows recent ships (dry-bulk) in transit on this route. Additionally, there are several ports in the Sea of Azov. In 2023/24, approximately 90% of Russian wheat exports are through Novo regional ports (Popva & Stolyarov, 2024; Reuters, 2024a).

[8] In addition, the rail shipping costs are subsidized (United States Trade Representative, 2024).

Table 3. Russian Grain Ports, 2023/24

Name	Owners	Port	Capacity /yr (mmt)	Loading volumes (mmt) 2022/2023	Loading volume (mmt) 2023/2024
KSK Grain terminal	Delo Group	Novorossiysk	9.0	7.65	8.84
NKHP	OZK and Demetra	Novorossiysk	7.1	6.10	8.35
Novorossiysk Grain Terminal	Demetra	Novorossiysk	6.5	6.18	7.35
Grain Terminal Complex Taman	Demetra	Taman	5.5	4.42	5.62
Port of Rostov-on-Don	several terminals	Rostov-on-Don	Unknown	5.03	5.03
Kavkaz Logistic	Aston	Kavkaz	5.4	5.30	5.32
Ultramarin M	private	Kavkaz	Unknown	2.23	2.84
Tuapse Grain Terminal	UCL Holding	Tuapse	2.0	1.79	2.67
Port of Azov	several terminals	Azov	Unknown	2.67	2.16
Linter	private	Kavkaz	Unknown	0.92	1.54

Source: Reuters 2024. Values are reported as received, acknowledging that some capacities may be less than the volumes shipped.

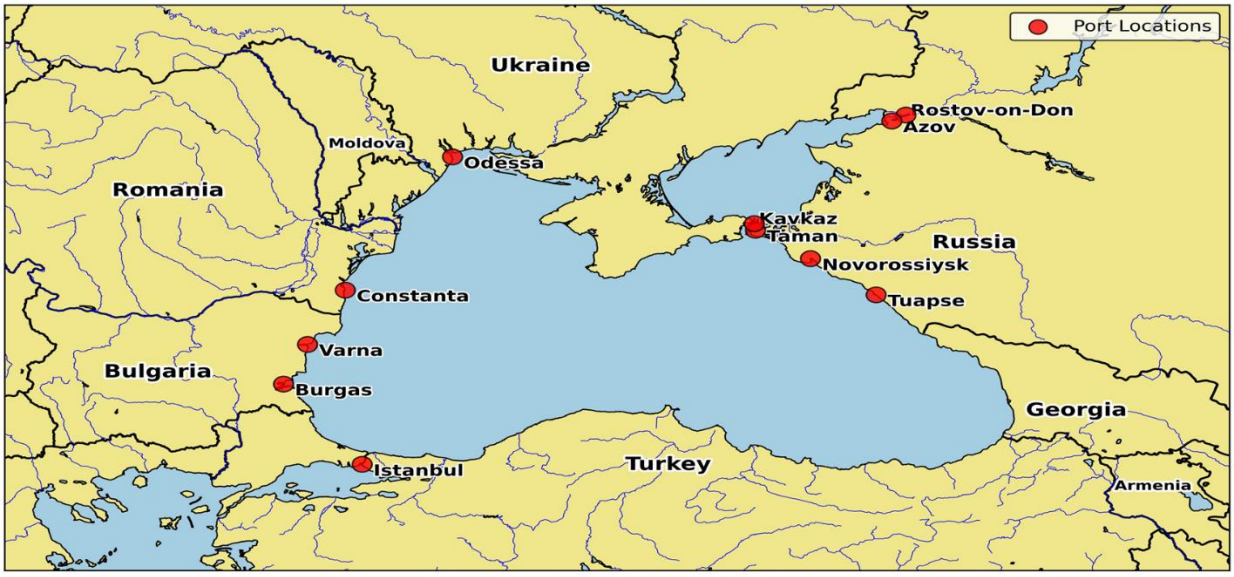

Figure 11. Black Sea Area Ports

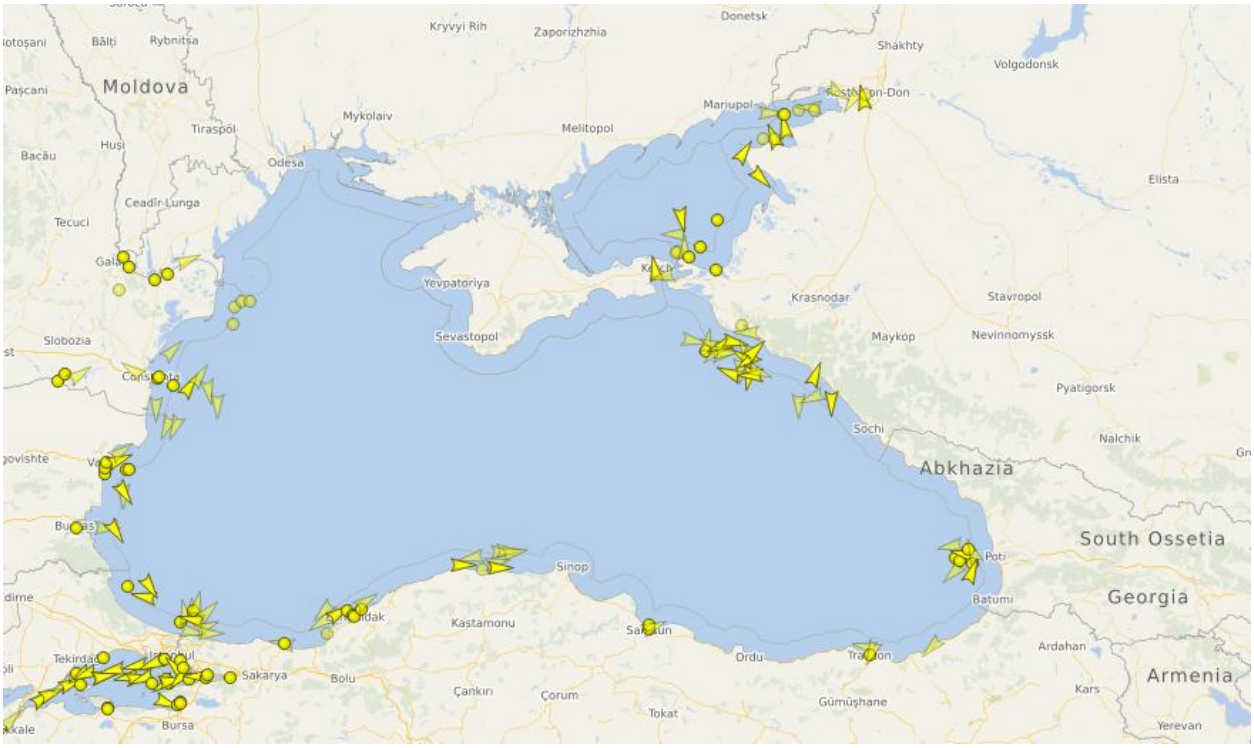

Figure 12. Black Sea Ships in Transit (Dec 16, 2024), Cargo Ships Only

Sources: Marinevesseltraffic.com

Russia is at varying stages of expanding its port capacity for exports (Popova & Stolyarov, 2024). Important reasons for this expansion include): 1) most port elevators are approaching

capacity; 2) there is a longer-term projection for expanded exports by 50% in 2030;[9] 3) the changing composition of import markets; and 4) that the Black Sea route and tributary ports have become increasingly congested and risky, due, in part to the war with Ukraine and restrictions on shipping (PortNews, 2023; Reuters, 2024c). Taken together, these developments are resulting in the expansion of port capacity and the development of more diverse routes.

Several ports and routes are at varying stages of development and/or have been targeted for expansion. Most prominent among these are two ports in the Gulf of Finland near St. Petersburg, with shipments passing through the Baltic Sea (Figures 13 and 14). These ports are referred to as the Russian Baltic ports and include Lugaport, with an estimated capacity of 7 MMT, and Vysotsky, with an estimated capacity of 8 million metric tons. It is expected that these Baltic ports could handle up to 25% of Russian grain exports. However, in 2025, the volume shipped through these ports is substantially less due to these ports being far from the wheat origin, the reduced crop, and the unavailability of railway allowances. These ports are designed to handle larger vessels and are more cost-effective than Azov for shipping to Africa and Asia.

Figure 13. St Petersburg Area Ports

[9] Technically, the claim is that "Putin set out a goal to increase agricultural exports by 50% by 2030 as part of a strategy to cement the country's position as an agriculture superpower…" (Popova and Stolyarov, 2024)

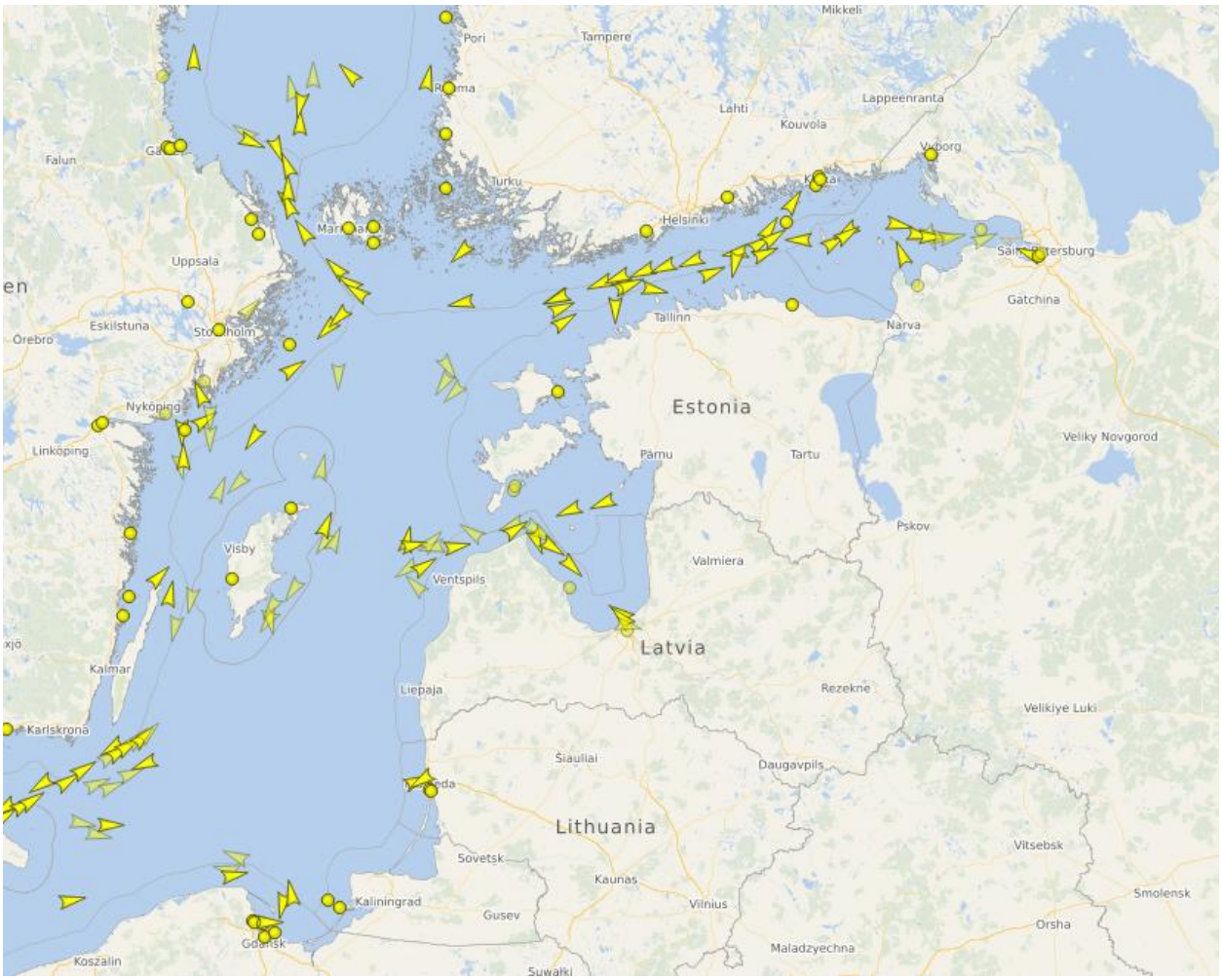

Figure 14. Gulf of Finland Area Ships in Transit (Dec 16, 2024), Cargo Ships Only

Sources: Marinevesseltraffic.com

Additionally, other routes are at various stages of exploration or development. One is for shipment through the Caspian Sea (Sukhankin, 2024). This would enable shipments from the interior of Russia through the Caspian Sea using both ship and rail, ultimately allowing shipments to India (Bloomberg, 2022). However, the depth of the Caspian Sea has been severely impacted by climate change (Mooney & Tauschinski, 2024). Of importance is that "As the waters become shallower, …it affected the "carriage capacity" of vessels, forcing them to carry fewer goods" ultimately raising the costs of shipping through this route.

Another new route is for shipments from producing regions (partly to be developed) in the Russian Far East to be sent directly by rail to China. Lastly, another route has been proposed to bypass the Bosporus Strait, which has become increasingly congested and risky (Wright, 2024). This would be an alternative canal parallel to the Bosporus, referred to as the "Istanbul Canal." This route is intended to rival shipments through the Suez Canal.

Changes in Russian Policies Impacting Logistics Competition:

Several policies were introduced in Russia that could impact exports. These include rail subsidies,[10] export taxes, export quotas, and targeting of friendly and unfriendly countries. The latter was in response to trade policies imposed following the beginning of the Russia-Ukraine war.

Export Taxes: The export tax regime is a crucial mechanism that affects domestic Russian prices. It was introduced in 2019 and appears to have commenced in 2021. This tax aims to control domestic prices to ensure adequate supplies and mitigate food price inflation.

The tax is derived weekly for each wheat, corn, and barley. It uses a specific formula tied to the FOB export price. Specifically, through 2022, the export tax was based on a target export price of $200 per metric ton and defined as [(FOB$ - $200) * 0.7]. Commencing in July 2022, it was based on the Russian ruble FOB export price and defined as [(FOB$ -13,875 RUR) * 0.7], and by mid-2024, it was [(FOB$ -17,000 RUR) * 0.7] (see Figure 15).

Figure 15. Russian Taxes on Wheat Exports, 2021 -2024
Source: Authors' calculations

Export Quotas: In 2019, a policy was introduced restricting the seasonal flows of grain exports from Russia. This policy remains in effect today and has become a crucial instrument influencing exports.

The Russian Export Quota operates as follows. Between July and January, there is no quota on exports (Bryanski, 2024). From mid-February to June, a quota is imposed on grain exports from Russia. The quota is announced before February of the market year. It seemingly is

[10] In addition, Russia has provided subsidies on rail shipments since 2017 for the transportation of agricultural products from interior to export destinations (United States Trade Representative, 2024, p. 311.

derived from the level of exportable supplies following production and exports in the first half of the marketing year. In particular, the quota is determined by the expected domestic demand in the last half of the marketing year and the expected level of desired ending stocks. Quota allocations to individual export firms for the second half of the marketing year are based on their shares of exports during the first half of the marketing year.

The level of export quota has varied over time. Table 4 shows the export quota from 2020 to the present. In some years, the export quota was for all grains, but in 2022, wheat had a separate quota. The table provides an estimate for wheat, assuming a wheat share of 72% (the value as of 2022). Significantly, this quota ranged from 8 to 21 million metric tons (MMT) and had an average of 14.3 MMT.[11]

Table 4. Russia Export Quota

Year (Calendar)	Month start	End Month	All Grains	Est for Wheat Only
2020	1	6	20	15
2021	2	6	18	13
2022	2	6	11	8
2023	2	6	26	19
2024	2	6	29	21
2025	2	6	0	11

There is discretion in the administration of the export quota mechanism. For example, in January 2025, a release indicated:

> *"Additionally, Russia may increase the share of wheat in grain exports in 2025 by limiting the export of corn, barley, and rye, with the total grain export quota being 10.6 million tons from February 15 to June 30, 2025." (Commersant, 2025).*

On the same day, Rosselkhoznadzor announced that it would target Morocco with 1 million metric tons (MMT) of wheat, and the first wheat shipments were to Togo (Milling, Middle East, and Africa, 2025). The quota may also change within the quota period. For example, for the

[11] Given the importance of the export quota, commodity analytic firms provide estimates of the expected quota. The estimates for the 2025 export quota during November 2024 were:

- Russia's IKAR consultancy anticipates export quotas in the second half of the 2024/25 season to be 11.5-12.0 million tons (revised to 11 mmt);
- Sizov, head of SovEcon consultancy, forecasted a quota of 10 million tons;
- Pavensky, head of the think tank at the leading Russian grain rail carrier Rusagrotrans, estimated the quota at 9-10 million tons.

In April 2022, the customs service (Russian) stopped publication of some export data to avoid "speculation."

2025 shipping period, the quota was initially set at 10.6 million metric tons (mmt). On February 18, 2025, the quota was reduced to 8.1 million metric tons of wheat (Popova, 2025). Although not immediately apparent, these quotas and changes in quotas pose substantial risks to export logistics from Russia and competing ports. [12]

Other Relevant Export Policies Impacting Logistics Demand and Competition

Targeting of Countries: In response to the geopolitical developments affecting trade since February 2022, Russia created a list of 'friendly' countries that may benefit from favorable trade terms. Russia also established a list of 'unfriendly' countries, many of which have imposed sanctions on Russian trade. For these countries, trade is entirely restricted or eliminated (BNE IntelliNews, 2023). Countries not included on either list are deemed 'neutral' by Russia and may or may not engage in trade relations. This policy represents a significant restriction on global wheat trade.

Russia's friendly countries list includes:[13] Azerbaijan, Armenia, Belarus, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan, Algeria, Bangladesh, Bahrain, Brazil, Venezuela, Vietnam, Egypt, India, Indonesia, Iran, Qatar, China, Cuba, South Africa, Malaysia, Morocco, Mongolia, United Arab Emirates, Oman, Pakistan, Saudi Arabia, Serbia, Thailand and Turkey.

Russia's unfriendly[14] countries list includes: Albania, Andorra, Australia, Austria, Bahamas, Belgium, Bulgaria, Canada, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Micronesia, Monaco, Montenegro, Netherlands, New Zealand, North Macedonia, Norway, Poland, Portugal, Romania, San Marino, Singapore, Slovakia, Slovenia, South Korea, Spain, Sweden, Switzerland, Taiwan, Ukraine, United Kingdom, United States and the European Union.

Discussions with international grain traders indicated that the Government of Russia designates 'unfriendly' countries as defined above. Then, the residual countries are considered 'friendly' or 'neutral'. In practice, Russia does not sell to unfriendly countries, and Russian exporters are prohibited from selling to third parties for shipment to these countries. It is not apparent that a mechanism exists that channels sales to friendly countries. Recent regulation changes are interpreted to mean that Russian exporting firms cannot sell to third parties that might ship to unfriendly countries. Some countries, including those in the EU, chose not to buy from Russia or established prohibitive import tariffs on Russian wheat and grains. Generally, it is not apparent that friendly countries receive special treatment in terms of pricing or shipping. Sometimes, special finance terms may exist, for example, Egypt receiving 180-day terms, and it is unclear whether the Government of Russia guarantees this risk or if it is a pricing condition. If

[12] The Ministry of Agriculture allocates quotas to individual firms based on first ½ of the marketing year shipments (APK 2025b, reporting from Interfax).

[13] This list is taken from BNE Intellinews (2023).

[14] Unfriendly countries were described in 2023 as (CHATGBT extracted Dec 2024): "… nations that have imposed sanctions or taken hostile actions against Russia."

so, it would be done on a case-by-case basis. However, there are intergovernmental agreements for Syria, Nicaragua, Cuba, and Venezuela, among others, which resulted in exceptions.

China Phytosanitary Regulations: In addition to the 'unfriendly country' sanctions, there are two important restrictions impacting wheat trade

These are phytosanitary restrictions for wheat shipments from Argentina and Ukraine to China. Each has been in place for many years. In response to the geopolitical developments following the Russia-Ukraine war, the Argentine phytosanitary restriction was lifted in November 2024 (Gilbert, 2024).

China has been negotiating its phytosanitary requirements for shipments from Ukraine for years, and Ukraine's exports of corn, barley, non-GM soybeans, sun meal, and oils have been approved. During the summer and fall of 2024, negotiations were underway to relax these restrictions (Tierney, 2024, citing APK). These negotiations were for peas, wheat flour, pet food, beef, corn, poultry meat, and aquatic products. It is anticipated that wheat will be included at some point.

Evolution of the Russian Grain Trading Industry:[15]

The Russian grain trading industry has undergone significant evolution. Traditionally (pre-1990s), Russia's grain trade was controlled by Exportkhleb (Crawford, 2022). Under Perestroika, the industry was largely decentralized (Wilson & Belozertsev, 1995), and various forms of commodity markets have evolved. Major international grain trading firms expanded into varying functions within the interior and offshore markets, but by no means dominated the industry.

Russian trading firms have also evolved. VTB[16] sought help from the Kremlin to create a Russian grain champion to curb the role of foreign traders (Houghton, 2019). Russia became concerned about food security following the imposition of Western sanctions in 2014. In 2019, the VTB consolidated its role in local grain marketing activities, expanding into trading, logistics, and port handling. VTB's grain holding company, Demetra, intended to control the supply chain and become a multinational giant; the company was partly owned by private firms and partially state-owned through VTB. Concurrently, United Grain Co. (https://ozk-group.ru) became a commercial company, was primarily state-owned, and sought to control the supply chain (it owns facilities, rail cars, etc.), becoming a dominant exporter from the Black Sea. Taken together, Russia evolved with two competing firms: state-owned and quasi-state-owned.

In late 2022, the Kremlin issued a decree prohibiting companies from "persons related to unfriendly states" from buying grain from Russian farmers. This action reduced trading opportunities for non-Russian firms and increased profits for Russian-trading firms. In early 2023, these developments, among others, effectively forced Western agricultural trading firms (including Cargill, LDC, and Viterra, as well as an earlier autonomous exit by Bunge) to liquidate their assets and exit Russia's grain-trade sector (Popva & Plume, 2023; Terazono, 2023).

[15] Extracted in part from Wilson, Bullock and Dubovoy (2025).

[16] Known as Vneshtorgbank, Внешторгбанк, or 'International Trade Bank' (https://www.vtb.ru).

By mid-2023, the Russian Ministry of Agriculture was intimately involved in grain export pricing and contracting.[17] The ministry aimed to reduce interior Russian prices to forestall inflation and earn a duty on exports. To this end, the ministry "informally fixed" minimum export prices.[18] Exporters had to register trade above the floor price and report their minimum purchase price. Any exporter that registered lower prices was penalized commercially (e.g., experienced difficulties with phyto-certificates, which are required for customs clearance). Indeed, Vorotnikov (2024) suggested that the Ministry of Agriculture compelled the consolidation of the Russian grain industry to enhance its ability to control its functions. Finally, during the fall of 2024, concerns were raised that international companies were purchasing FOB grain from Russian exporters and re-exporting it to their final destinations. The Ministry of Agriculture was attempting to confirm this and sought to eliminate re-exporting by non-Russian trading firms.

The structure of the Russian grain export industry has undergone radical evolution (Glauber, 2023a; IFPRI, 2023; Quinn, 2024a, 2024b). Early in 2023, Grain Gates was the dominant exporting firm, followed by TD RIF (Grain Flower, previously known as GTS) and Aston. Quinn (2024a) noted that the top five exporters accounted for 58% of the exports. The only multinationals reported were Dreyfus and COFCO. By 2023/24, most Western trading firms had exited the country. Grain Gates, TD RIF, and Aston were the dominant exporting firms. TD RIF has since exited (AgriCensus, 2024a; Belikova, 2024; Quinn, 2024b). Grain Gates is formally a private company but is associated with Demetra, which, in turn, is associated with VTB.[19]

Figure 16 illustrates the market shares of Russian exports for grains and oilseeds (Wilson, Bullock and Dubovoy, 2025). These were derived using export shipments in the world grain trade from 2020 to 2023. The results show the dominance of Russia's grain trading firms. The largest is TradeHouse RIF.[20]

[17] Traders reported that the Ministry of Agriculture began executing a two-price system: one for private transactions and one for public tenders. .

[18] This practice has come to be known as the "AgMin" floor (Reuters, 2023a) or is referred to as the "unofficial price set by the Russian agriculture ministry."

[19] Details on the changes in the structure of the international grain trading industry, and that in Russia, are described in Wilson, Bullock and Dubovoy (2025).

[20] These results differ from Quinn (2024a and b) due to the scope of analysis, and time period, but they are generally consistent. Further, Belikova (2024) indicated that the Russian export industry has evolved to an oligopoly led by Grain Gates which is affiliated with Demetra Trading.

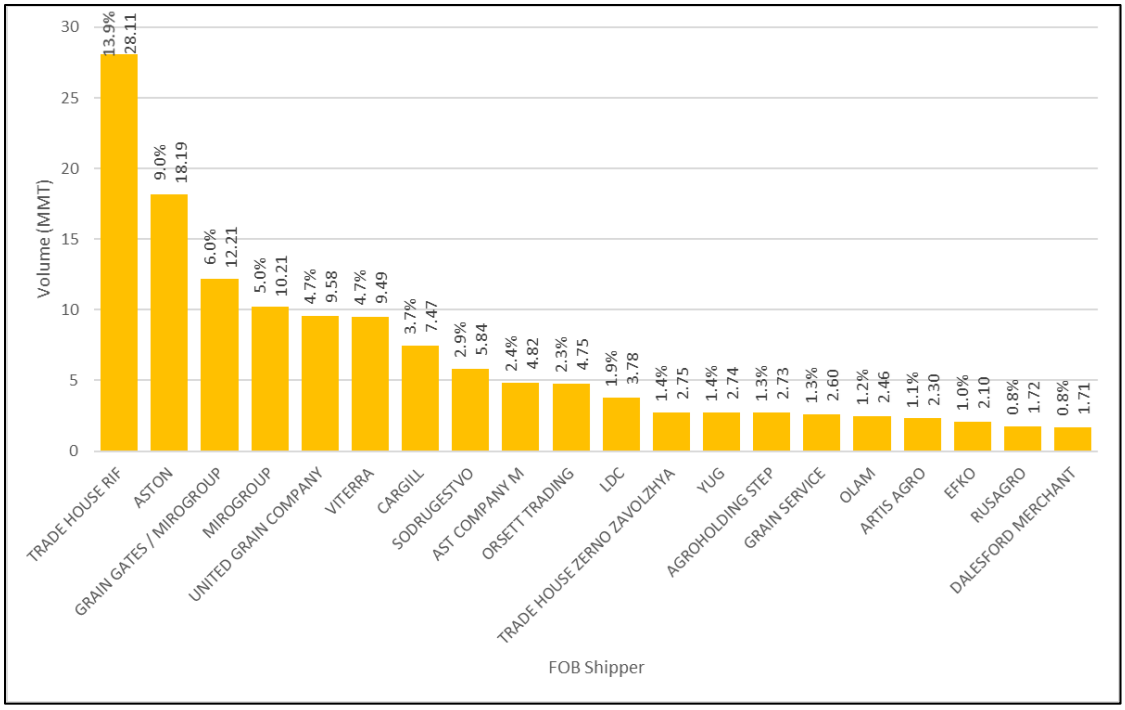

Figure 16. Volumes and Market Shares for FOB shipments for grains and oilseeds from Russia, Top 20 Firms, All Commodities, All Destinations, 2020-2023 (Values for each bar are market share and volume)

Taken together, the critical points for this study are that 1) Russia is a significant exporter, particularly of wheat; 2) following privatization, many Western trading firms were active in Russia's grain exports; 3) due in part to sanctions in 2014, there were efforts to establish domestic Russian grain trading firms; and 4) following the Russia-Ukraine war, western firms were forced to exit, replaced by a cabal of Russian trading firms which are now consolidating to a few dominant exporters.

Previous Studies:

There have been several recent studies on the impacts of the Russian-Ukraine war. Most of these studies focused on price dynamics (e.g., Heigermoser, 2023; Heigermoser, Götz, and Svanidze, 2021; Yugay et al., 2024), volatility (Bullock et al., 2023; Carter & Steinbach, 2023a), and trade (Ahn, Kim and Steinbach, 2022).

Most published studies on the changing logistics in the Black Sea focused on Ukraine. The studies analyzed the influence of logistical changes on trade and markets (Mykhailova et al., 2023; Jagtap et al., 2022; Pavlenko et al., 2023; Bezpartochnyi et al., 2023). Wilson, Lakkakula, and Bullock (2024) analyzed the changes in the Ukrainian logistical system in international corn trade flows. They documented the drastic changes in logistical costs, constraints, and routes due to the Russia-Ukraine war and simulated their impact on international corn flows. Bullock and Wilson (forthcoming) specified a similar model of these changes and developed longer-term (10-year) projections of flow changes. These studies used an Optimized Monte Carlo Simulation (OMCS) network flow model. Each of these studies focused on changes in flows, capacity

restrictions, utilization, and costs. Changes in logistical costs, constraints, and export supplies would be important changes in corn trade flows.

Empirical Model

As described above, significant changes are occurring in Black Sea shipping that will impact competition in shipping and logistics for wheat. This study develops a model to capture these changes and the risks associated with critical variables. The empirical model specification is an Optimized Monte Carlo Simulation (OMCS) used to determine the optimal trade flows between specified origins and destinations. The model's important features are described below, and further details can be found in Appendix A. The model builds on previous similar specifications as used by Wilson, Lakkakula, and Bullock (2024) for corn and by Kamrud, Wilson, and Bullock (2023) and Wilson and Bullock (2024) for soybean competition.

The model seeks to find the trade flows that minimize shipping costs from export ports to import market destinations. The base model restricts import demand, export supplies, and handling capacity. Additional restrictions include varying marketing and trade policies. Restrictions were added related to unfriendly countries, the export quota, expanded Russian ports, and a potential 50% increase in exports by 2030. Sensitivity analyses were conducted to evaluate the impacts of each of these variables.

One of the costs included in the model is export FOB prices, which are defined as futures plus basis. The other significant cost is ocean shipping from each port of origin to each destination (defined as a country or region). Most of these variables are stochastic, represented in the model as distributions, and correlated. Ocean rates for specific routes are further represented using regression procedures that take into account fuel costs, the BDI (Baltic Dry Index), and distance.

Wheat classes in the model include US HRW and SRW, which are typically considered competitive with those from Russia. Other competing exporters for these classes include Ukraine, the EU, Australia, and Argentina. The specific ports for US shipments are the PNW and the US Gulf. The port areas for Ukraine shipments include Odesa and Constanta, Romania while those for Russia include Novorossiysk, Azov, and the Caspian, in addition to the Baltic ports. The import regions include North Africa, Africa (primarily Sub-Saharan), the Middle East, Asia, Southeast Asia, North America, South America, and the rest of the world. They are similar to those used by the USDA long-term projections. Some countries concerning Russian trade policy were defined as ‘unfriendly’ (as described above) and were separated within the region.

Results

Overview:

The detailed results for the base case are shown first. Then, the results for the sensitivity analyses are shown and compared to the base case results.

The base case defines the spatial competitive environment. The base case utilizes the FOB basis, accounting for ocean shipping costs during this period, as well as exportable supplies, capacities, and demands. Policies described above that impacted logistics during this period were imposed, but the new ports and sanctions/friendly countries were not restrictive.

Sensitivities were specified to analyze the impacts of 1) new ports and routes for Russian shipments, 2) phytosanitary restrictions, 3) Russian export quotas, 4) Russian restrictions of exports to countries designated as 'unfriendly', 5) a minimum export price, and 6) a projected increase in Russian exports.

Base-Case Results:

Base-case trade flows, including inter-port competition, are presented and discussed first, followed by an examination of the seasonality of trade flows and the effects of port and supply constraints, as well as associated risks. The base case assumes the 2023 logistical functions, costs, and constraints and that the ocean shipping costs are a function of energy prices (as described in Appendix A). The model was simulated to produce projections for the calendar years 2025 and 2026; however, in some cases, we only present results for 2026, as the results are extensive. The base case is described in detail in Appendix A, and additional results are presented in Appendix B.

The base case results are shown in Tables R1-R4. Table R1 presents the market shares and volumes of each export port/region in each import market region. These approximately reflect the market shares that prevailed in the early 2020s. The results indicate that Russia has a decisive competitive advantage in the Middle East market from a logistics standpoint, with an average share of 97% across all simulation scenarios. Russia also holds a dominant position in exports to Southeast Asia (54% share) and Turkey (90% share). Australia is in a dominant position for winter wheat exports into Asia (50% share) and competes strongly with Russia for the Southeast Asia market (41% share). As expected, Argentina is very competitive for the South American market (72% share). The EU dominates the North (71% share) and Sub-Saharan (65% share) markets. The United States, while not dominating any market, has a significant share of the Asia, North African, South American, and Mexican markets (which are dominated by Ukraine).

In practice, Ukraine is not a major exporter to Mexico. The reason for this is quality. Russian wheat has a higher protein content than other wheat varieties. Hence, the base case was revised with a restriction that precludes shipments from Ukraine to Mexico. The results are shown in Table R2. The results are similar, except that Russia is now a major exporter to Mexico, competing directly with the United States, which holds a dominant share of the market at 58 percent, while Russia accounts for 40 percent. In practice, volumes shipped from the 'Black Sea' to Mexico vary but are generally consistent with these results. On average, excluding Ukraine from the Mexican market is expected to increase U.S. winter wheat exports to Mexico by approximately 1.5 million metric tons per year in 2025 and 2026.

Table R3 shows the capacity utilization by the export port. The values indicate the percentage of simulation scenarios where the port's capacity is constrained and shipments are limited. These results suggest that there is adequate capacity for winter wheat exports from the U.S., Australia, Argentina, and the EU. However, seasonal capacity issues do arise occasionally for the Ukrainian (Odesa), Constanta) and Russian (Black Sea and Sea of Azov) ports. In Ukraine, restrictions typically arise from August to October. In Russia, the ports are primarily constrained from August to December. This is likely due primarily to the unusually weak FOB basis at these

ports during these months and to the impact of the export quota mechanism on seasonal exports.

A significant feature of the international wheat trade is its seasonality. As discussed, seasonal behavior is important in several critical export variables, including basis, import demand, export supply, port capacity, and ocean shipping rates. These variations differ across countries and affect export origins in varying ways. Table R4 (and Appendix Figures B1 and B2) illustrates this by showing the seasonal behavior of the exports by origin from the optimization model. The results show that for each country, there are seasonal peaks and valleys, and these differ across ports. Notably, the peaks for each country are as follows: the United States in April and September; Australia in January-June; Argentina in December-March; the EU in March-April and again in August-September; Ukraine in August-November; and Russia in August-December.

Table R1. Base Case Flows and Market Shares Under Optimal Cost Minimization

United States												
Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	1,160	1,005	0	4,361	318	30	0	1,157	2,268	0	1,202	11,501
2026	1,440	1,016	0	4,269	489	37	0	1,057	2,198	0	1,350	11,854
Percent of Total												
2025	10.1%	8.7%	0.0%	37.9%	2.8%	0.3%	0.0%	10.1%	19.7%	0.0%	10.4%	100.0%
2026	12.1%	8.6%	0.0%	36.0%	4.1%	0.3%	0.0%	8.9%	18.5%	0.0%	11.4%	100.0%

Australia												
Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	16	6	5	12,569	5,719	0	0	0	147	0	106	18,566
2026	16	6	19	12,840	5,627	0	0	0	193	0	117	18,817
Percent of Total												
2025	0.1%	0.0%	0.0%	67.7%	30.8%	0.0%	0.0%	0.0%	0.8%	0.0%	0.6%	100.0%
2026	0.1%	0.0%	0.1%	68.2%	29.9%	0.0%	0.0%	0.0%	1.0%	0.0%	0.6%	100.0%

Argentina												
Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	416	635	35	796	129	16	156	0	9,538	0	666	12,388
2026	538	728	55	762	182	17	152	0	9,814	0	807	13,054
Percent of Total												
2025	3.4%	5.1%	0.3%	6.4%	1.0%	0.1%	1.3%	0.0%	77.0%	0.0%	5.4%	100.0%
2026	4.1%	5.6%	0.4%	5.8%	1.4%	0.1%	1.2%	0.0%	75.2%	0.0%	6.2%	100.0%

EU												
Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	18,684	14,239	38	2,306	0	16	0	10	0	0	32	35,325
2026	18,818	15,172	84	2,051	0	17	0	13	0	0	19	36,173
Percent of Total												
2025	52.9%	40.3%	0.1%	6.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	100.0%
2026	52.0%	41.9%	0.2%	5.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	100.0%

Ukraine												
Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	2,474	1,897	0	2,155	4	676	0	2,617	556	912	40	11,331
2026	2,002	1,709	0	2,561	15	666	0	2,904	419	982	31	11,288
Percent of Total												
2025	21.8%	16.7%	0.0%	19.0%	0.0%	6.0%	0.0%	23.1%	4.9%	8.0%	0.4%	100.0%
2026	17.7%	15.1%	0.0%	22.7%	0.1%	5.9%	0.0%	25.7%	3.7%	8.7%	0.3%	100.0%

Russia												
Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	3,140	4,121	20,592	3	7,304	0	0	653	0	8,392	1,667	45,871
2026	3,049	4,101	20,809	0	7,431	0	0	539	0	8,435	1,573	45,938
Percent of Total												
2025	6.8%	9.0%	44.9%	0.0%	15.9%	0.0%	0.0%	1.4%	0.0%	18.3%	3.6%	100.0%
2026	6.6%	8.9%	45.3%	0.0%	16.2%	0.0%	0.0%	1.2%	0.0%	18.4%	3.4%	100.0%

Table R2. Base Case Flows and Market Shares Restricting Ukraine Wheat Shipments to Mexico

United States												
Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	810	660	0	3,782	318	28	0	2,527	2,220	0	1,155	11,501
2026	947	708	0	3,518	501	33	0	2,715	2,110	0	1,322	11,854
Percent of Total												
2025	7.0%	5.7%	0.0%	32.9%	2.8%	0.2%	0.0%	22.0%	19.3%	0.0%	10.0%	100.0%
2026	8.0%	6.0%	0.0%	29.7%	4.2%	0.3%	0.0%	22.9%	17.8%	0.0%	11.2%	100.0%

Australia												
Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	3	11	7	12,051	6,247	0	0	0	133	0	114	18,566
2026	12	1	21	12,363	6,119	0	0	0	182	0	118	18,817
Percent of Total												
2025	0.0%	0.1%	0.0%	64.9%	33.6%	0.0%	0.0%	0.0%	0.7%	0.0%	0.6%	100.0%
2026	0.1%	0.0%	0.1%	65.7%	32.5%	0.0%	0.0%	0.0%	1.0%	0.0%	0.6%	100.0%

Argentina												
Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	412	641	35	777	136	15	156	0	9,538	0	677	12,387
2026	578	755	42	696	187	16	151	0	9,818	0	810	13,053
Percent of Total												
2025	1.5%	1.5%	6.1%	5.0%	2.3%	0.1%	1.3%	0.0%	77.0%	0.0%	5.2%	100.0%
2026	1.6%	2.3%	6.8%	4.6%	2.2%	0.2%	1.2%	0.0%	75.2%	0.0%	6.0%	100.0%

EU												
Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	18,726	14,513	31	1,993	0	15	0	20	0	0	29	35,325
2026	18,759	15,606	64	1,682	0	16	0	28	0	0	18	36,173
Percent of Total												
2025	53.0%	41.1%	0.1%	5.6%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	100.0%
2026	51.9%	43.1%	0.2%	4.7%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	100.0%

Ukraine												
Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	2,972	2,136	0	3,607	20	680	0	0	555	1,282	80	11,331
2026	2,515	1,779	0	4,299	36	671	0	0	421	1,513	53	11,288
Percent of Total												
2025	26.2%	18.8%	0.0%	31.8%	0.2%	6.0%	0.0%	0.0%	4.9%	11.3%	0.7%	100.0%
2026	22.3%	15.8%	0.0%	38.1%	0.3%	5.9%	0.0%	0.0%	3.7%	13.4%	0.5%	100.0%

Russia												
Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	2,990	3,955	20,619	3	6,754	0	0	1,869	0	8,023	1,659	45,871
2026	3,013	3,917	20,868	0	6,901	0	0	1,760	0	7,904	1,575	45,938
Percent of Total												
2025	6.5%	8.6%	44.9%	0.0%	14.7%	0.0%	0.0%	4.1%	0.0%	17.5%	3.6%	100.0%
2026	6.6%	8.5%	45.4%	0.0%	15.0%	0.0%	0.0%	3.8%	0.0%	17.2%	3.4%	100.0%

Table R3. Base Case Percent of Shipments Limited by Port Constraints

OBS Num	Month	US - PNW	US - Gulf	Australia	Argentina	EU	Ukr- Odesa	Ukr- Constanta	Russia - Black Sea	Russia - Azov
1	Nov-24	0%	0%	0%	0%	0%	0%	0%	100%	2%
2	Dec-24	0%	0%	0%	0%	0%	0%	0%	100%	6%
3	Jan-25	0%	0%	0%	0%	0%	0%	0%	0%	0%
4	Feb-25	0%	0%	0%	0%	0%	0%	0%	0%	0%
5	Mar-25	0%	0%	0%	0%	0%	0%	0%	0%	0%
6	Apr-25	0%	0%	0%	0%	0%	0%	0%	0%	0%
7	May-25	0%	0%	0%	0%	0%	0%	0%	0%	0%
8	Jun-25	0%	0%	0%	0%	0%	0%	0%	0%	0%
9	Jul-25	0%	0%	0%	0%	0%	0%	0%	0%	0%
10	Aug-25	0%	0%	0%	0%	0%	40%	39%	100%	81%
11	Sep-25	0%	0%	0%	0%	0%	50%	40%	100%	76%
12	Oct-25	0%	0%	0%	0%	0%	5%	39%	99%	16%
13	Nov-25	0%	0%	0%	0%	0%	0%	0%	100%	9%
14	Dec-25	0%	0%	0%	0%	0%	0%	0%	100%	13%
15	Jan-26	0%	0%	0%	0%	0%	0%	0%	0%	0%
16	Feb-26	0%	0%	0%	0%	0%	0%	0%	0%	1%
17	Mar-26	0%	0%	0%	0%	0%	0%	0%	0%	0%
18	Apr-26	0%	0%	0%	0%	0%	0%	0%	0%	0%
19	May-26	0%	0%	0%	0%	0%	0%	0%	0%	0%
20	Jun-26	0%	0%	0%	0%	0%	0%	0%	0%	0%
21	Jul-26	0%	0%	0%	0%	0%	0%	0%	0%	0%
22	Aug-26	0%	0%	0%	0%	0%	43%	33%	100%	90%
23	Sep-26	0%	0%	0%	0%	0%	52%	37%	100%	79%
24	Oct-26	0%	0%	0%	0%	0%	9%	32%	98%	18%
25	Nov-26	0%	0%	0%	0%	0%	0%	0%	98%	12%
26	Dec-26	0%	0%	0%	0%	0%	0%	0%	100%	13%
	2025 Ave	0%	0%	0%	0%	0%	8%	10%	42%	16%
	2026 Ave	0%	0%	0%	0%	0%	9%	9%	41%	18%

Table R4. Seasonal Behavior of Projected Exports, by Port and Origin Country (000 mt)

Month	US - PNW	US - Gulf	Total U.S.	Australia	Argentina	EU	Ukr-Odesa	Ukr-Constanta	Total Ukraine	Russia - Black Sea	Russia - Azov	Total Russia	Overflow	Total All
Nov-24	418	184	601	824	539	2,813	262	921	1,183	4,473	238	4,711	6	10,677
Dec-24	597	128	725	1,622	1,406	3,058	433	417	850	4,473	250	4,723	-	12,383
Jan-25	339	266	605	1,940	2,226	2,541	365	314	679	3,499	-	3,499	7	11,496
Feb-25	421	405	826	1,751	1,697	2,730	374	303	677	2,667	-	2,667	619	10,966
Mar-25	321	616	938	1,961	1,345	3,330	358	311	670	2,679	-	2,679	1,286	12,208
Apr-25	398	686	1,084	1,799	889	3,426	336	311	647	2,673	5	2,678	1,273	11,796
May-25	427	568	995	1,951	647	2,654	289	289	578	2,280	4	2,284	1,080	10,189
Jun-25	430	527	957	1,770	633	2,073	274	166	440	2,203	-	2,203	733	8,808
Jul-25	408	549	957	1,496	658	2,680	372	244	616	3,326	-	3,326	91	9,823
Aug-25	597	548	1,145	1,263	574	3,580	999	638	1,636	4,473	667	5,140	60	13,398
Sep-25	435	598	1,033	1,156	482	3,370	1,075	733	1,808	4,473	633	5,106	13	12,967
Oct-25	266	479	745	918	408	2,849	775	761	1,536	4,472	499	4,972	141	11,568
Nov-25	257	252	508	837	596	2,900	619	547	1,166	4,473	331	4,804	1	10,813
Dec-25	365	142	507	1,618	1,566	3,162	506	331	838	4,473	375	4,848	-	12,538
Jan-26	323	229	552	1,974	2,307	2,630	449	220	669	3,514	-	3,514	2	11,648
Feb-26	443	414	857	1,782	1,780	2,827	408	260	668	2,662	7	2,669	523	11,106
Mar-26	349	617	967	1,995	1,428	3,450	431	229	660	2,680	-	2,680	1,176	12,356
Apr-26	389	729	1,118	1,830	944	3,548	394	244	638	2,679	-	2,679	1,185	11,943
May-26	445	581	1,026	1,985	687	2,749	321	248	569	2,303	-	2,303	1,012	10,331
Jun-26	455	532	986	1,801	672	2,147	297	136	434	2,222	-	2,222	680	8,942
Jul-26	462	539	1,002	1,493	685	2,715	424	192	617	3,326	-	3,326	95	9,932
Aug-26	585	583	1,168	1,262	599	3,626	1,064	587	1,651	4,473	681	5,154	97	13,558
Sep-26	476	605	1,081	1,161	497	3,407	1,108	700	1,808	4,473	655	5,128	33	13,116
Oct-26	241	532	774	925	424	2,886	964	573	1,537	4,467	505	4,972	171	11,689
Nov-26	227	269	496	836	620	2,958	686	481	1,167	4,468	371	4,840	9	10,926
Dec-26	327	152	479	1,656	1,605	3,209	529	309	839	4,473	406	4,879	-	12,667

Sensitivity Analyses

Critical variables and constraints impacting logistics competition were subject to sensitivity analyses. The results for each are discussed below.

Simulation 1a: Baltic Ports Open but Restricted:

One of the alternative scenarios is the impact of Russia's expansion in export capacity on shipments through the Baltic. These new elevators are just beginning to ship in 2025 and are somewhat restrictive, in part due to wheat supply and rail shipping mechanisms. However, the potential expansion of the Black Sea is important. The model was evaluated with the restriction that the maximum shipments from the Baltic Ports would be at a capacity of 2.8 million tons (author's calculations).[21]

The results are shown in Table R5 (and Appendix Table B1) and reported as changes relative to the base case (Table R1). The results show that shipments from the Baltic ports could increase by 2.9 million metric tons (MMT) by shifting a portion of the added export volume from the Black Sea and the Sea of Azov. Shipments from the Baltic are primarily to Sub-Saharan Africa, the Middle East, and Turkey. A portion of this shift is due to seasonal restrictions at the Black Sea and Azov (Table R3). The United States would need to find a new home for approximately 550K metric tons of winter wheat per year under this scenario, based on the increase in the 'Other' destination category. Most of this would be due to increased exports from the EU to Asia (due to

[21] In 2025, industry representatives indicated that these are new ports and hence their shipments are limited to wheat that can be trucked to the ports. This is in part due to the rail carriers not providing favorable allowances for this movement (as discussed above), in addition to the restricted supplies tributary to the Baltic. In May 2025, APK (as reported by Tierney, 2025) indicated that Russian wheat was shipped to Egypt for the first time, and used to conduct tests of the facilities. They indicated Egypt was the 16th country through these ports "confirming the development of logistics routes via the ports of the Baltic Sea."

displacement from Middle East and African markets), which would compete with U.S. exports to Asia. Australia would also experience a minor negative impact from this scenario due to export displacement.

Table R5. Baltic Ports Open but Restricted: Change from 2025 Base Case Results

Calendar Year 2025 (1,000 MT)												
Import Region	Total U.S.	Australia	Argentina	EU	Ukr-Odesa	Ukr-Constanta	Total Ukraine	Russia - Black Sea	Russia - Azov	Russia - Baltic	Total Russia	Overflow
North Africa	-76	0	-1	407	0	-23	-23	-351	0	82	-269	-38
Sub-Saharan Africa	-81	0	-58	-910	0	-113	-113	-774	0	1,946	1,172	-9
Middle East (ex Turkey)	0	1	0	0	0	0	0	-687	0	641	-46	45
Asia (ex SE Asia)	-279	-35	-13	453	-99	0	-99	0	0	0	0	-26
SE Asia	-21	-94	6	0	0	0	0	109	0	0	109	0
European Union	-3	0	-1	1	-2	1	-1	0	0	4	4	0
U.S. East Coast	0	0	15	0	0	0	0	0	0	0	0	-15
Mexico	-41	0	0	-1	-2	0	-2	42	0	0	42	2
South America (ex Arg)	-52	20	-31	0	0	97	97	0	0	0	0	-33
Turkey	0	0	0	0	119	0	119	604	-1,040	317	-119	0
Other	553	108	84	50			24				-894	-75
Total	0	0	0	0	14	-38	0	-1,057	-1,040	2,991	0	-150
Total (excl Other)	-553	-108	-84	-50	14	-38	-24	-1,057	-1,040	2,991	894	-75

Simulation 1b: Baltic Ports Open and Unrestricted

Given the prospective importance of the Baltic ports, the model was revised to accommodate greater shipments through these ports, based on the proposed elevator capacity of 2.8 million tons per month. The results are shown in Table R6. The results indicate a significant shift to the Baltic ports. Specifically, exports from the Baltic would increase by 9.3 million metric tons (mmt), while the Black Sea and Sea of Azov would see a decline of 7.5 mmt. All other exporting origins would decline. The most significant decline is from the US, where approximately 860,000 metric tons of winter wheat would need to find a new home due to displacement from the Asian, North African, and South American markets.

The world wheat flows would change dramatically with unlimited access to the Baltic ports. Notably, Russia is expected to expand shipments significantly to Sub-Saharan Africa by 2.5 million metric tons. There would also be reduced shipments from Russia to Turkey and Southeast Asia. Shipments from both Australia and the EU are expected to increase to Asia and Southeast Asia to offset reduced exports from Russia.

The opening of the Baltic port areas impacts the restrictions on Russia's ports. Specifically, the Black Sea and Azov are less constrained than in the base case. Other port restrictions are not significantly impacted. However, the Baltic port restrictions remain high, suggesting that these restrictions would impact shipments.

Table R6. Baltic Ports Open & Unrestricted: Change in 2026 Base Case Exports by Origin

Calendar Year 2026 (1,000 MT)										
Import Region	Total U.S.	Australia	Argentina	EU	Total Ukraine	Russia - Black Sea	Russia - Azov	Russia - Baltic	Total Russia	Overflow
North Africa	-155	0	-93	855	-43	-649	0	121	-528	-36
Sub-Saharan Africa	-89	-1	-74	-2,124	-197	-1,227	0	3,739	2,511	-26
Middle East (ex Turkey)	0	1	0	-4	0	-3,909	0	3,851	-58	61
Asia (ex SE Asia)	-467	-393	4	1,113	-195	0	0	0	0	-62
SE Asia	-16	119	97	0	-4	-197	0	0	-197	1
European Union	-3	0	0	5	-7	0	0	5	5	0
U.S. East Coast	0	0	17	0	0	0	0	0	0	-17
Mexico	-34	0	0	46	-23	12	0	0	12	0
South America (ex Arg)	-97	28	-49	0	165	0	0	0	0	-47
Turkey	0	0	0	0	236	224	-1,806	1,346	-236	0
Other	861	246	98	109	68				-1,509	-127
Total	0	0	0	0	0	-5,747	-1,806	9,061	0	-253
Total (excl Other)	-861	-246	-98	-109	-68	-5,747	-1,806	9,061	1,509	-127

Simulation 1c: Baltic and Caspian Ports Open at Full Capacity:

Another port or route development in Russia is for shipments through the Caspian route. This was described above and, like the Baltic, is under development. Ultimately, shipments from this port would result in a lower-cost route or alternative for Russian grain shipments to the east, via the Caspian Sea. This simulation relaxed the constraint imposed on that route and the Baltic routes.

The results are summarized in Tables R7 and B2. They indicate that there would be a slight increase in Russian exports and a shift in the direction of Russian exports. There would be a decline in Russian exports to the Middle East and North Africa, and an increase in exports to Southeast Asia through the Caspian route. These would be offset by reductions from other exporters, primarily from the United States to Asia and Australia to Southeast Asia. Of course, these ports are only at varying stages of development, and the total costs of shipping through these routes may be understated.

Table R7. Baltic and Caspian Ports Open: Change in 2026 Base Case Exports by Origin

Calendar Year 2026 (1,000 MT)													
Import Region	Total U.S.	Australia	Argentina	EU	Ukr-Odesa	Ukr-Constanta	Total Ukraine	Russia - Black Sea	Russia - Azov	Russia - Baltic	Russia-Caspian	Total Russia	Overflow
North Africa	77	27	-1	420	0	31	31	-645	0	94	0	-550	-4
Sub-Saharan Africa	173	21	20	-1,639	0	-263	-263	-783	0	2,478	0	1,694	-7
Middle East (ex Turkey)	4	71	47	70	0	0	0	-4,209	0	3,364	0	-845	654
Asia (ex SE Asia)	-826	1,006	-141	998	-242	2	-240	0	0	0	0	0	-798
SE Asia	-131	-1,417	4	0	-10	0	-10	-3,256	0	0	4,813	1,557	-3
European Union	0	0	1	3	-10	2	-8	0	0	4	0	4	0
U.S. East Coast	0	0	14	0	0	0	0	0	0	0	0	0	-14
Mexico	18	0	0	37	-66	0	-66	13	0	0	0	13	-1
South America (ex Arg)	-190	46	-49	0	0	147	147	0	0	0	0	0	46
Turkey	0	0	0	0	335	0	335	622	-2,174	1,217	0	-335	0
Other	875	246	106	110			74					-1,537	-127
Total	0	0	0	0	7	-81	0	-8,259	-2,174	7,156	4,813	0	-253
Total (excl Other)	-875	-246	-106	-110	7	-81	-74	-8,259	-2,174	7,156	4,813	1,537	-127

Simulation 2: Removal of China Phytosanitary restrictions on Argentine and Ukraine Wheat:

Phytosanitary requirements are a constraint on trade in most agricultural commodities. China has been more restrictive on this non-tariff barrier than other countries. In 2023, China relaxed its phytosanitary restrictions on corn from Argentina and Brazil, resulting in a significant shift toward these exporting origins. In the case of wheat, China also has phytosanitary restrictions from Argentina and Ukraine. It is unclear, but China is negotiating with Ukraine to relax these restrictions.

The base case model assumes that phytosanitary restrictions limited wheat exports from Argentina and Ukraine to China. In this simulation, these restrictions are relaxed. The results are in Table R8 and Table B3. The results indicate there would be extremely minor changes in trade flows due to seasonal effects. Given the international spatial competition among exporting ports and routes, Argentina and Ukraine would still not be competitive in the Asian market, indicating that the phytosanitary restrictions have little to no effect upon global winter wheat trade.

Table R8. China Phyto Restrictions Lifted: Change in 2026 Base Case Exports by Origin

Calendar Year 2026 (1,000 MT)							
Import Region	Total U.S.	Australia	Argentina	EU	Total Ukraine	Total Russia	Overflow
North Africa	18	0	-52	40	-3	-5	3
Sub-Saharan Africa	-18	0	52	-40	3	5	-3
Middle East (ex Turkey)	0	0	0	0	0	0	0
Asia (ex SE Asia)	-9	9	0	0	0	0	0
SE Asia	9	-9	0	0	0	0	0
European Union	0	0	0	0	0	0	0
U.S. East Coast	0	0	0	0	0	0	0
Mexico	0	0	0	0	0	0	0
South America (ex Arg)	0	0	0	0	0	0	0
Turkey	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0
Total (excl Other)	0	0	0	0	0	0	0

Simulation 3: Russia Lifting of Export Quota (unconstrained):

The export quota is a crucial feature of Russian grain marketing, influencing seasonal flows, as illustrated in the base case. In that case, as illustrated, the seasonal Russian export quota has a significant impact on the seasonal behavior of shipments from Russian and other ports. Relaxing this restriction has a dramatic impact on the results (Tables R9 and B4). Most apparent, Russian exports would increase by about 2.4 million metric tons (mmt) relative to the base case. The increased shipments would mostly be shipped to Southeast Asia, North Africa, and the Middle East. This is because more seasonal shipments occur during the second half of the marketing year. The reductions in exports from other exporting origins are relatively minor. The exception is the 'overflow origin', which would likely include Kazakhstan and re-exports through Turkey, as

well as other winter wheat origins not included in the model definition. Specifically, there are fewer wheat shipments from overflow origins in this case.

Table R9. Unrestricted Russia Export Quota: Change in 2026 Base Case Exports by Origin

Calendar Year 2026 (1,000 MT)							
Import Region	Total U.S.	Australia	Argentina	EU	Total Ukraine	Total Russia	Overflow
North Africa	-289	-8	-61	-94	25	646	-218
Sub-Saharan Africa	-151	0	-61	150	-46	187	-78
Middle East (ex Turkey)	0	-10	-55	-66	0	470	-338
Asia (ex SE Asia)	386	966	95	9	70	0	-1,526
SE Asia	26	-957	-5	0	0	949	-14
European Union	-3	0	-1	2	4	0	-2
U.S. East Coast	0	0	16	0	0	0	-16
Mexico	-101	0	0	-4	35	74	-4
South America (ex Arg)	33	2	-3	0	2	0	-34
Turkey	0	0	0	0	-89	89	0
Other	99	7	76	5	0	0	186
Total	0	0	0	0	0	2,415	-2,042
Total (excl Other)	-99	-7	-76	-5	0	2,414	-2,228

Simulation 4: Russia Removes 'Unfriendly' Country Restrictions:

Another important policy impacting trade is the Russian designation of 'friendly' and 'unfriendly' countries for trade purposes (see above for description). Russia currently does not have trading relations with countries designated as 'unfriendly'. In the base case, Russian exports to each destination region were constrained to the percentage of 'friendly' and 'neutral' countries multiplied by the import demand for each region. In this case, Russian exports were constrained to exclude the demand from countries listed as 'unfriendly'. Details on this procedure are described in Appendix A.

In this simulation, the restriction on exports to "unfriendly" countries was completely relaxed (all were set to 100% friendly or neutral). Results are presented in Tables R10 and B5, indicating that the policy has little to no significant impact on global trade flows. Even without the restrictions, Russia exports little to no wheat to those countries on the 'unfriendly' list due to logistical disadvantages. The main impact is primarily a slight reallocation of some Russian exports from Africa (both North and Sub-Saharan) to Southeast Asia, as exports from that region to one country on the 'unfriendly' list (i.e., Singapore) increase.

Table R10. Russia Removes Unfriendly Country Restrictions: Change in 2026 Base Case Exports by Origin

Calendar Year 2026 (1,000 MT)							
Import Region	Total U.S.	Australia	Argentina	EU	Total Ukraine	Total Russia	Overflow
North Africa	2	0	2	17	-2	-19	0
Sub-Saharan Africa	2	0	2	18	5	-27	0
Middle East (ex Turkey)	0	0	0	0	0	0	0
Asia (ex SE Asia)	-2	39	0	-35	-2	0	0
SE Asia	-5	-40	-4	0	-1	50	0
European Union	0	0	0	0	0	0	0
U.S. East Coast	0	0	0	0	0	0	0
Mexico	1	0	0	0	1	-2	0
South America (ex Arg)	1	0	0	0	-2	0	0
Turkey	0	0	0	0	1	-1	0
Other	0	0	0	0	0	-1	0
Total	0	0	0	0	0	0	0
Total (excl Other)	0	0	0	0	0	1	0

Simulation 5: Russia Imposes Minimum Price of $250/mt:

An important intervention in the Russian wheat market is establishing a minimum price of $250 per metric ton. While this is a clear policy goal, the administration's ability to achieve it is less certain. This uncertainty arises partly because the reported export prices frequently fall below this target price. To assess the impacts of this goal, the minimum export price from Russia was set at $250 per metric ton. If the simulated price falls below this threshold, exports will be prohibited and, by definition, shift to other competitors' markets.

The results are shown in Tables R11 and B6. The impact of this simulation indicates that exports from Russia would decrease by 742,000 metric tons. This would be offset by increases mainly from the US and Argentina exports. Exports from Russia decreased primarily to Southeast Asia, Turkey, and Africa (both North Africa and Sub-Saharan Africa). Exports from Ukraine would also be significantly impacted due to shifts from Mexico to replace Russian exports to Turkey and Africa (North and Sub-Saharan). EU exports would decrease to Asia but increase in Africa (North and Sub-Saharan), among others. The U.S. would gain exports to Mexico (partially replacing Ukraine) by shifting volume from North Africa, Other Destinations, and Asia.

Table R11. Russia Imposes Minimum Price of $250/mt: Change in 2026 Base Case Exports by Origin

Calendar Year 2026 (1,000 MT)							
Import Region	Total U.S.	Australia	Argentina	EU	Total Ukraine	Total Russia	Overflow
North Africa	-502	-7	62	340	291	-185	1
Sub-Saharan Africa	-250	1	2	133	324	-183	-27
Middle East (ex Turkey)	0	1	-15	-15	0	47	-19
Asia (ex SE Asia)	-341	-528	-12	-584	1,515	0	-49
SE Asia	10	565	91	0	26	-692	0
European Union	156	0	79	112	-357	0	11
U.S. East Coast	0	0	-1	0	0	0	1
Mexico	1,456	0	0	19	-2,339	860	4
South America (ex Arg)	-62	-5	6	0	-18	0	80
Turkey	0	0	0	0	589	-589	0
Other	-467	-28	-212	-5	-30	742	0
Total	0	0	0	0	0	0	0
Total (excl Other)	467	28	212	5	30	-742	0

Simulation 6: Russia Exports Grow by 10% per Year: The Russian government's agricultural trade goal is to increase exports by 50% by 2030. Our model only covers data for 2026. We simulated a 10% per year increase through 2026 to accommodate this export increase.

Results are shown in Tables R12 and B7. The results indicate Russian exports would increase by 1.7 mmt to the modeled regions, excluding "other"[22] markets, and by 6.6 mmt including "other". The simulation results indicate that most of the increase would go to other destinations. Among the import destinations, the most significant increase would be export shipments to North Africa and Africa. In this case, port capacity in the Azov would become an issue. The most significant losses to the modeled regions would be exports from the US, followed by those from Argentina and Australia. Most of the additional Russian exports would go to North Africa, Southeast Asia, and Sub-Saharan Africa; however, the "Other" category would increase by 4.96 million metric tons (mmt), indicating that Russia would need to find new markets (outside the 10 explicitly modeled) to accommodate its growth in export volume.

[22] "Other" is defined as all other markets not specifically represented in the countries and regions explicitly included in the model (and shown in the Tables).

Table R12. Russia Exports Grow by 10%/Year: Change in 2026 Base Case Exports by Origin

Calendar Year 2026 (1,000 MT)							
Import Region	Total U.S.	Australia	Argentina	EU	Total Ukraine	Total Russia	Overflow
North Africa	-126	0	-117	-314	30	563	-36
Sub-Saharan Africa	-92	-3	-84	-116	-121	437	-22
Middle East (ex Turkey)	0	0	0	-1	0	15	-14
Asia (ex SE Asia)	-183	74	-55	405	51	0	-292
SE Asia	-50	-417	-32	0	-2	501	0
European Union	-3	0	-2	3	3	0	-1
U.S. East Coast	0	0	22	0	0	0	-22
Mexico	-109	0	0	-4	-1	115	-1
South America (ex Arg)	3	86	-45	0	94	0	-138
Turkey	0	0	0	0	-57	57	0
Other	561	260	313	27	2	4,957	6,121
Total	0	0	0	0	0	6,645	5,596
Total (excl Other)	-561	-260	-313	-27	-2	1,688	-524

Summary and Conclusions

The Russia-Ukraine war has had drastic impacts on international grain markets. For Ukraine, the immediate impacts of the war meant increased logistical costs, port capacity constraints, the development of alternative routes, and changes in international trade flows. For Russia, additional pressures have been emerging. Most important are 1) shipments through traditional Black Sea routes are now subject to capacity constraints, are riskier due to the war and higher ocean shipping costs, in part due to war insurance, and 2) the development of new ports in the Baltic Sea. Furthermore, the marketing system and exports have shifted from a highly spatially competitive market to one in which the Russian government has greater control. Most important are the imposition of export quotas, export prices, and the specification of the targeted "friendly countries."

This project aims to develop a model for export logistics and trade flows related to wheat, evaluating the potential impacts of changes to the export regime in the Black Sea region. A model was created to identify the most efficient trade flows and routes from export ports to importing regions and countries. This model focuses on the wheat classes that compete with those from Russia, Ukraine, the U.S. (HRW and SRW), the EU, Argentina, and Australia. Costs include export FOB basis and ocean shipping fees.

Results illustrate the spatial competition in this market. Asia, South America, and Mexico are the most significant markets for the United States. Key competitors in these regions include Australia and Argentina. Russia is a prominent U.S. competitor in Mexico, with a competitive advantage in the Middle East, North Africa (including Egypt), Sub-Saharan Africa, and Turkey. Additionally, Russia is expanding its presence in the Southeast Asian market.

Two sets of results from the base case are important for logistics competition. First, the results indicated that the capacity for most ports is adequate except for the Russian and

Ukrainian ports. Restricted capacity is highly seasonal. Ukraine's ports are restricted (with potential demand exceeding monthly capacity) from August to October, and Russian ports are restricted from August to December. Second, the nature of the seasonality of most of the critical variables impacting logistics decisions. Many of this model's critical variables are seasonal, including import demand, export supply, basis, and ocean rates. The effect of these seasonal variables results in seasonality in exports, which varies by port and country. The results indicate that the United States would have peaks in April-September, Australia in January-June, Argentina in December-March, the EU in March-April and again in August-September, Ukraine in August-November, and Russia in August-December.

Several simulations were evaluated to assess their impact on the logistical functions. The results of these are:

- Expanding Russian infrastructure to include the Baltic ports (500,000 tons per month) results in a reduction in shipments from Novorossiysk and Azov by approximately 2.1 million metric tons per year, with a 3.0 million metric ton increase from the Baltic ports. The primary loser in this scenario is the United States, which would need to find a new volume of approximately 553,000 metric tons per year (outside the 10 modeled destinations). The other exporting countries (Australia, Argentina, the EU, and Ukraine) would also have to find additional outside volume, but to a lesser extent.
- Expanding to include the Baltic ports and the Caspian Sea route results in additional shifts in the flow. There is a shift in Russian shipments to Sub-Saharan Africa and Southeast Asia, accompanied by a decrease in shipments to the Middle East and North Africa. It is essential that these routes are at various stages of development, and the costs of shipping through these routes may be underestimated. The United States would again be the primary loser under this scenario, having to find additional volume of 875,000 mt per year with the remaining exporters (Australia, Argentina, the EU, and Ukraine) also experiencing export displacement.
- Relaxing China's phytosanitary requirements on Argentina and Ukraine has no impact on existing trade flows, as neither country has competitive logistics into the Asian region. Some very minor reallocations of exports may occur due to one-off seasonal effects.
- The lifting of the Russian Export Quota has a significant impact. Russian exports increase by approximately 2.4 million metric tons from the base case, with a corresponding change in seasonality, resulting in more Russian exports during the second half of the marketing year. This increase in exports comes primarily at the expense of the “Overflow” exporting countries not defined in the model (such as Kazakhstan and Turkey), followed by the United States and Argentina.
- Removing the Russian “Unfriendly Country” designation has a minor impact on the results. Specifically, if this restriction is relaxed, there will be a minor increase in Russian shipments to Southeast Asia, accompanied by slight decreases in exports to Africa (both North and Sub-Saharan Africa). The increase in Southeast Asia would be

the result of Singapore being dropped from the “unfriendly” list. Russian exports are logistically uncompetitive to the other countries on the “unfriendly” list (primarily the EU and the United States).

- Russian Minimum Price of $250/mt: Russia is enforcing a strict minimum FOB export price of $250 per metric ton, resulting in a net reduction of 742,000 metric tons to the 10 defined importing regions, which Russia would have to offset through increases to the “Other” regions. The primary beneficiaries of this policy would be the United States and Argentina, with minor benefits accruing to Ukraine and Australia.
- Expanding total exports from Russia by 10% per year over the 2025 and 2026 calendar years results in increased Russian exports to North Africa, Southeast Asia, and Sub-Saharan Africa, with minor increases to Mexico and Turkey. However, Russia would have to find an additional 5.0 million metric tons of demand (outside the 10 regions) to accommodate the export growth. The United States, Argentina, and Australia would also have to find significant outside growth to avert major losses in total exports. This is primarily due to USDA projections of significantly slower growth in import demand (1.2% per year) from the 10 modeled regions.

References

Addinsoft. 2024. "XLSTAT Statistical and Data Analysis Solution." (version 2024.3.0). New York, USA: Addinsoft. Available online at https://www.xlstat.com.

AgriCensus. 2021. "Dry bulk freight rates ease amid heightened volatility." Accessed October 13, 2021, from Agricensus.com.

AgriCensus. 2023. "UN's AMIS warns of 'significant challenge' ahead for Grain Corridor," April 6, 2023.

AgriCensus, 2024a. "Russia posts record wheat exports for 2023/24; structural changes for importers, exporters" FastMarkets AgriCensus Daily Report, July 8, 2024.

AgriCensus 2024b. "Uncertainty grows for Ukraine's agriculture businesses amid new mobilization law." *Agricultural Daily Report*, May 24, 2024.

Ahn, S., D. Kim, and S. Steinbach. 2022. "The impact of the Russian invasion of Ukraine on grain and oilseed trade." *Agribusiness*, Volume 39, Issue 1. Winter 2023, pp. 291-299. https://doi.org/10.1002/agr.21794

Belikova, M. 2024. "Russia's competition protection committee reports 'oligopoly,' 'monopoly' behaviors in grain market," Fastmarkets, Dec 17, 2024.

Belikova, M. and Y. Sukharska. 2024. "Concerns have been mounting over a potentially significant reduction in Russia's grain export quota for the second half of the 2024/25 marketing year," Fastmarkets.

Belikova, M. and E.Hughes. 2025. "Atlantic freight rates up; Black Sea sees little eft from ceasefire." Fastmarkets. March 26, 2025

Bezpartochnyi, M., I. Britchenko, and L. Prylutska. 2023. "Research on export logistics of agricultural products in Ukraine during martial law and ensuring food security." *The Management of Socio-Economic Systems in Terms of Globalization Challenges: Scientific Monograph. Košice, Vysoká škola bezpečnostného manažérstva v Košiciach, 2023, pp. 479-498. https://doi.org/10.5281/zenodo.7798978.*

Bloomberg. 2022. "Russia and Iran Are Building a Trade Route Stretching from the Eastern Edge of Europe to the Indian Ocean", Dec 21, 2022. https://www.bloomberg.com › graphics › 2022-russia-...

BNE IntelliNews. 2023. "Russia issues list of friendly and neutral countries," FacebookTwitterLinkedInTelegramFlipboardFeedly September 24, 2023

bne IntelliNews - Russia issues list of friendly and neutral countries

Bryanski, G. 2024. "Russia cuts wheat exports among measures to curb inflation," Nov 29, 2024. Reuters

Bullock, D.W., P. Lakkakula, and W.W. Wilson. 2023. "Russia-Ukraine conflict and the global food grain price analysis." *Choices*, Vol 38(2), pp. 1-9.

Carter, C. and S. Steinbach. 2023a. “Did grain futures prices overreact to the Russia-Ukraine war.” Online at https://mpra.ub.uni-muenchen.de/118248/ MPRA Paper No. 118248, posted 09 Aug 2023 13:36 UT

Carter, C. and S. Steinbach. 2023b. “Russian weaponization of food rattles global markets.” *ARE Update*, 26(6): 1-4. University of California Giannini Foundation of Agricultural Economics.

Commersant. 2025. “Russia increases wheat exports at the expense of corn,” Jan 20, 2025. Available at https://commersant.ge/en/news/worl/russia-increases-wheat-exports-at-the-expense-of-corn

Crawford, R., 2022. Limit Up, Agronomics Publishing.

Data Transmission Network. 2024. “ProphetX.” (version 4.11.1.6).

Daryo News (not dated). Russia reveals list of 'friendly' nations granted special trading privileges, available at https://daryo.uz/en/2023/09/25/russia-reveals-list-of-friendly-nations-granted-special-trading-privileges#:~:text=In%20a%20move%20that%20marks%20a%20significant%20development,granted%20special%20privileges%20in%20trading%20on%20Russian%20finan

Dubois, M. 2023. “Russia issues list of friendly and neutral countries,” September 26, 2023. available at Russia issues list of friendly and neutral countries - Deutsches Asienforschungszentrum

Fastmarkets. 2024. Renamed from “AgriCensus.” Available online at https://www.fastmarkets.com/

Fastmarkets. 2024. “AgriCensus.” Available online at www.agricensus.com.

Federal Reserve Bank of St. Louis. 2024. “FRED Economic Data.” Available online at https://fred.stlouisfed.org/.

Figueira, G., and B. Almada-Lobo. 2014. “Hybrid Simulation–Optimization Methods: A taxonomy and discussion.” *Simulation Modeling Practice and Theory,* 46: 118-134. doi: 10.1016/j.simpat.2014.03.007.

Gilbert, J. 2024. “Argentina Seeks Its First Wheat Shipments to China in Decades,” Bloomberg, Nov 29,2024, Available at https://www.bloomberg.com/news/articles/2024-11-29/argentina-seeks-its-first-wheat-shipments-to-china-in-decades

Glauber, J. 2023a. “The impacts of the war in Ukraine on global markets—One year later.” Presentation to the USDA’s 99th annual Agricultural Outlook Forum 23 February 2023 Available at https://www.usda.gov/sites/default/files/documents/2023aof-Glauber.pdf

Glauber, J. 2023b. “Ukraine one year later: Impacts on global food security,” *IFPRI Blog*: Issue Post Feb 23, 2023 open access | cc-by-4.0 available at https://www.ifpri.org/blog/ukraine-one-year-later-impacts-global-food-security

Heigermoser, M, L. Götz and M. Svanidze. 2021 Price formation within Egypt's wheat tender market: Implications for Black Sea exporters. Agricultural Economics 2021; 52:819–831. https://doi.org/10.1111/agec.12656.

Heigermoser, M. 2023 The rapid rise of Russia's wheat exports: Price formation, spot-futures relations and volatility effects, Studies on the Agricultural and Food Sector in Transition Economies, No. 100, ISBN 978-3-95992-152-7, Leibniz Institute of Agricultural. Available at https://www.econstor.eu/bitstream/10419/268616/1/1833732642.pdf Development in Transition Economies (IAMO), Halle (Saale)

Houghton, T., 2019. "TIMELINE: VTB's Growing Influence in the Russian Grain Market," Agri Census. 24 Dec 2019.

IFPRI. 2023. Market Concentration in the Grain Industry: Implications for Food Security? September 7, 2023. Available at https://vimeo.com/862099895

Investing.com. 2024. "Investing.Com Database." Internet Database. Available online at www.investing.com.

Jagtap, S., H. Trollman, F. Trollman, G. Garcia-Garcia, C. Parra-López, L. Duong, W. Martindale, P.E.S. Munekata, J. Lorenzo, A. Hdaifeh, et al. 2022. "The Russia-Ukraine conflict: Its implications for the global food supply chains." *Foods,* 11, no. 14: 2098. https://doi.org/10.3390/foods11142098.

Kamrud, G., W.W. Wilson, and D.W. Bullock. 2023. "Logistics competition between the U.S. and Brazil for soybean shipments to China: An Optimized Monte Carlo Simulation Approach." *Journal of Commodity Markets,* 31: 100290. doi: 10.1016/j.jcomm.2022.100290.

Milling: Middle East and Africa. 2025. "Russia targets 1 million tonnes of wheat exports to Morocco in 2024/2025, Jan. 20, 2025." Available at https://millingmea.com/russia-targets-1-million-tonnes-of-wheat-exports-to-morocco-in-2024-2025/

Mooney, A. and J. Tauschinski, 2024. "Caspian Sea on UN Climate summit doorstep ebbs towards record low," Financial Times. November 30, 2024.

Mykhailova, M., O. Yatsenko, Y. Zavadska, O. Afanasieva, and R. Haas. 2023. "The War in Ukraine and its impact on global agricultural trade." *Die Bodenkultur: Journal of Land Management, Food and Environment*, vol.74, no.2, 2023, pp.91-105. https://doi.org/10.2478/boku-2023-0008.

Palisade Software. 2023. "@Risk: Advanced Risk Analysis for Microsoft Excel." (Version 8.3.2 [Build 42] Industrial Edition). Ithaca, NY: Palisade Software, Inc.

Pavlenko, O., D. Muzylyov, V. Ivanov, M. Bartoszuk, and J. Jozwik 2023. "Management of the grain supply chain during the conflict period: Case study Ukraine." https://doi.org/10.22306/al.v10i3.406.

Popva, O., and K. Plume., 2023. "Cargill to Halt Grain Loadings at its Russian Export Terminal, Financial Times, March 29, 2023.

Popova, O. and G. Stolyarov. 2024. “Russia expands Baltic ports as it eyes new grain markets,” Sept 26, 2024. Reuters.

Popova, O. 2025. Russian grain export volumes will be well below quotas in Feb-June, analysts say, Reuters, Feb 18, 2025.

PortNews. 2023. “Russia’s First Deep-Water Grain Terminal in the Baltic Area Opens in the Port of Vysotsk.,” September 2. Available online at https://en.portnews.ru/news/353121/#:~:text=Russia%27s%20first%20deep%2Dwater%20grain%20terminal%20in%20the,the%20seaport%20of%20Vysotsk%2C%20the%20Leningrad%20Region . [Accessed Oct. 15, 2024].

Quinn, A. 2024a. “R*ussia Grain Traders Grab Market Control After Westerners’ Exit,”* Bloomberg. January 15, 2024.

Quinn, A. 2024b. “New Top Russian Grain Trader Emerges as Rival Falls Out of Favor*,”* Bloomberg. July 30, 2024.

Refinitiv. 2023a. “Eikon.” [the former Thompson Reuters data platform]

Ren, H. 2021. “Higher shipping costs are here to stay, sparking price increases.” Accessible at https://www.bloomberg.com/news/articles/2021-04-12/higher-shipping-costs-are-here-to-stay-sparking-price-increases. Available at Higher Shipping Costs Are Here to Stay, Sparking Price Increases - BNN Bloomberg.

Reuters. 2023. “Poland halts Ukraine grain imports.” April 9, 2023.

Reuters, 2024a. “Russia’s grain exports: A look at main terminals and planned expansions,” Sept 26, 2024. Reuters.

Reuters, 2024b. “Russia’s tacit grain export curbs cause market confusion, Oct 31, 2024.

Reuters. 2024c. “Russia’s Grain Exports: A Look at Main Terminals and Planned Expansions.,” September 26. Available online at https://www.reuters.com/markets/commodities/russias-seaborne-grain-exports-look-main-terminals-planned-expansions-2024-09-26/#:~:text=In%20the%202023%2F2024%20season%2C%2056.5%20million%20tons%2C%20or,tons%20from%209%20million%20tons. [Accessed Oct. 22, 2024].

Rudyk, Y., T. Bubela, and K. Maciuk. 2023. Russia-Ukraine war: Transport and logistics support for grain supply chain in regional food safety.” *Scientific Journal of Silesian University of Technology*. Series Transport, 119, 223-233. doi:10.20858/sjsutst.2023.119.13.

Savchuk, M. and M. Dudchenko. 2024. “How Russia Exports Ukrainian Grain As Its Own: An Investigation”. Radio Free Europe, July 2, 2024. Available at https://www.rferl.org/a/ukraine-russia-war-occupation-grain-shipments/33004062.html

Scheuerman, K. 2023. “Weaponizing wheat: How strategic competition with Russia could threaten American food security-Analysis.” 2023. National Defense University Press, JOINT FORCE QUARTERLY 1114th Quarter, October 2023 https://ndupress.ndu.edu/JFQ/Joint-Force-Quarterly-

111/Article/Article/3569549/weaponizing-wheat-how-strategic-competition-with-russia-could-threaten-american/ and at Eurasia review, November 6, 2023 https://www.eurasiareview.com/06112023-weaponizing-wheat-how-strategic-competition-with-russia-could-threaten-american-food-security-analysis/.

Schuler, M. 2024. "War risk insurance challenges in the wake of Russia-Ukraine." gCaptain, May 29, 2024, available at ttps://gcaptain.com/war-risk-insurance-challenges-in-the-wake-of-russia-ukraine-war/?subscriber=true&goal=0_f50174ef03-ca276eba20-170583239&mc_cid=ca276eba20&mc_eid=65e2c906ff.

Seddon, M., A. Stognei, P. Ivanova, C. Campbell, D. Clark, S. Joiner, and C. Nevitt. "How long can Russia keep fighting the war in Ukraine." *Financial Times*, FEBRUARY 21, 2023. Available at How long can Russia keep fighting the war in Ukraine? (ft.com).

Sukhankin, S. 2024. "Russia Hopes to Use Caspian Sea Route to Evade Sanctions, March 6, 2024. Eurasia Daily Monitor Vol 21(35).

Terazono, E., 2023. Cargill to "Scale Back" in Russia but Continue Food Operations. Financial Times, March 22, 2023

Tierney, W. 2024. "APK - Ukraine wants to export more ag to China; Kazakhs and Russians still don't have ag transport agreement; Ukraine has shipped 8 MMT of wheat," market letter. Nov 4, 2024.

Tierney, W. 2025. "Russia has sent wheat to Egypt via a Baltic Sea port for the first time," market letter citing APK, May 29, 2025.

United Nations. 2024. "UN Comtrade Database." Internet Database. Available online at https://comtradeplus.un.org/. [Accessed Sep. 20, 2024].

U.S. Energy Information Administration. 2023. *Annual Energy Outlook*. AEO2023. Washington, D.C.: U.S. Department of Energy, Energy Information Administration. Available online at https://www.eia.gov/outlooks/aeo/. [Accessed Sep. 15, 2023].

USDA Interagency Agricultural Projections Committee. 2023. *USDA Agricultural Projections to 2032*. Long-Term Projections Report OCE-2023-1. Washington, D.C.: United States Department of Agriculture. Available online at https://www.ers.usda.gov/webdocs/outlooks/105853/oce-2023-01.pdf?v=6622.2. [Accessed Sep. 1, 2023].

USDA-AMS. 2024. "Grain Transportation Report Datasets." Internet Database. Available online at https://www.ams.usda.gov/services/transportation-analysis/gtr-datasets. [Accessed Sep. 22, 2024].

USDA-FAS. 2024. "Global Agricultural Trade System. Foreign Agriculture Service." U.S. Department of Agriculture. April 2024, and December 2024. Available at grain.pdf

United States Trade Representative, 2024. 2024 National Trade Estimate Report on FOREIGN TRADE BARRIERS. Washington, DC.

van Brugen, I. 2024. "Russian Railway Networks Facing 'Imminent Collapse': Report" Newsweek. Available at Russian Railway Networks Facing 'Imminent Collapse': Report

Verzun, A., O. Voinycha, O. Fedyk, O. Shulha, L. Lipych, T. Shmatkovska, and V. Herylo. 2023. "Export potential of agricultural-industrial complex of Ukraine: Logistics and development prospects." Scientific Papers Series Management, *Economic Engineering in Agriculture and Rural Development*, Vol. 23, Issue 4, 2023 PRINT ISSN 2284-7995, E-ISSN 2285-3952.

Vorotnikov, V. 2024. Russia Tightens Grip on Grain Industry. World Grain, July 12, 2024. Available at https://www.world-grain.com/articles/20211-russia-tightens-grip-on-grain-industry

Wilson, W. W. and A. Belozertsev, 1995. Russian Grain Trading and Marketing: Evolution and Struggles. *Agribusiness: An International Journal* 11(1):1-12, 1995.

Wilson, W. and D. W. Bullock. 2024. "Non-Tariff and Tariff Impediments Impacting Spatial Competition Between the United States and Brazil for Soybean Shipments to China" *China Agricultural Economic Review*. Forthcoming DOI: 10.1108/CAER-12-2023-0373.

Wilson, W. and D. W. Bullock, 2025. "The Long-Term Logistical Implications and Risks for the Russian Invasion of Ukraine on Global Corn Trade Flows" *European Review of Agricultural Economics.* (forthcoming).

Wilson, William W., David W. Bullock, and Isaac Dubovoy. 2025. "Dynamic Changes in the Structure and Concentration of the International Grain and Oilseed Trading Industry." *Applied Economic Perspectives and Policy* 1–22. https://doi.org/10.1002/aepp.13524

Wilson, W., P. Lakkakula, and D.W. Bullock. 2024. "Implications of the Russian invasion on the logistical competition for corn shipments from the United States and Ukraine." *Journal of Agricultural and Resource Economics,* 49(1). Unknown: 162-184. doi: 10.22004/AG.ECON.337556.

Wilson, W. W., Prithviraj Lakkakula and David W. Bullock, 2021. "Logistical Competition for Corn Shipments from The United States and Ukraine to Targeted International Markets", NDSU Agribusiness and Applied Economics Report No. 811, October 2021. Also published as *GTR Highlight: USDA Research Compares U.S. and Ukrainian Logistics in Exporting Corn*.

Wright, E. 2024. "Incredible new £20bn megaproject in Europe set to rival the Suez Canal," Oct 9. 2024. Daily Express. Available at ttps://www.msn.com/en-gb/travel/news/incredible-new-20bn-megaproject-in-europe-set-to-rival-the-suez-canal/ar-AA1rXGDy

Yugay, Stanislav; Götz, Linde; Svanidze, Miranda (2024) : Impact of the Ruble exchange rate regime and Russia's war in Ukraine on wheat prices in Russia, Agricultural Economics, ISSN 1574-0862, Wiley, Hoboken, NJ, Vol. 55, Iss. 2, pp. 384-411, https://doi.org/10.1111/agec.12822 , https://onlinelibrary.wiley.com/doi/10.1111/agec.12822

Appendix A: Detailed Model Specification and Empirical Procedures

Overview:

This study employs a method known as Optimized Monte Carlo Simulation (OMCS) to determine the optimal trade routes between specific starting points and destinations. OMCS combines simulation and optimization. It uses random data generated from a Monte Carlo simulation and then improves the model based on this data. This process repeats for each simulation round, and at the end, we summarize the optimized results.

The decision-maker can view the random data before selecting the best course of action. The Monte Carlo simulation helps create realistic scenarios for the model's data. This differs from traditional methods, where simulation reveals the risks and uncertainties that the decision-maker faces.

In this study, the decision-maker examines the random data for each period and then determines the optimal trade routes based on that data and the model's structure. This happens repeatedly over the forecast period. Here, the decision-maker is a theoretical global decision-maker who can manage all trade flows to minimize overall logistics costs while considering infrastructure and policy limits.

This method is helpful because it can manage seasonal, random, and linked data, which can be modeled using Monte Carlo simulations. The OMCS framework generates many realistic scenarios. It focuses on clear optimization, allowing us to analyze how logistics costs, constraints, and trade policies affect the most cost-effective trade routes.

Model Specification:

This study uses an optimization model to calculate trade flows from 10 origin ports in 6 countries to 10 destination regions. The origin ports are located in the United States, Ukraine, Russia, the European Union, Argentina, and Australia. Specifically, the U.S. ports are located in the Gulf and the Pacific Northwest, while ports for Ukraine's grain include Odesa and Constanta, Romania for transshipment purposes. For Russia, the ports are in the Black Sea, the Sea of Azov, the Baltic Sea, and the Caspian Sea. Rouen is the port for the European Union, Rosario for Argentina, and Gladstone for Australia.

The destination regions include North Africa, Sub-Saharan Africa, the Middle East, Asia, Southeast Asia, the European Union, Mexico, South America (excluding Argentina), and the East Coast of the United States. These origin and destination groupings are similar to those used by the USDA in their long-term baseline projections. A Monte Carlo simulation model was developed in Microsoft Excel (Microsoft Corporation, 2024) using the @Risk add-in (Palisade Software, 2024). This model generated monthly forecasts from November 2024 to December 2026, encompassing the calendar years 2025 and 2026. Each forecast period was treated as an independent simulation, utilizing the same fixed seed value for random number generation. This approach ensures the generation of consistent results by producing the same sequence of random forecasts for each period.

At each iteration of the Monte Carlo simulation, the following linear programming problem was solved using the Excel solver with the simplex algorithm enabled:

$$\min_{x_{i,j,t}} \widetilde{C}_t = \sum_{i=1}^{10}\sum_{j=1}^{10} \tilde{p}_{i,j,t} \cdot x_{i,j,t} \text{ for all } t = 1, \ldots, 26 \text{ months},$$

subject to:

$$x_{i,j,t} \geq 0,$$

$$\sum_{j=1}^{10} x_{i,j,t} \leq M_{i,t} \text{ for all i} = 1, \ldots, 10 \text{ origin ports}, \quad \text{(A1)}$$

$$\sum_{j=1}^{10} x_{i\in k,j,t} \leq \tilde{Q}_{k,t} \text{ for all k} = 1, \ldots, 6 \text{ origin countries},$$

$$\sum_{i=1}^{10} x_{i,j,t} \geq \widetilde{D}_{j,t} \text{ for all } j = 1, \ldots, 10 \text{ destinations},$$

where *i* is a subscript for the origin port, *j* is a subscript for the destination region, *k* is the subscript for the exporting country, and *t* is a subscript for the month, $x_{i,j,t}$ is the total volume (MMT) shipped, $\tilde{p}_{i,j,t}$ is the simulated random CIF price to ship corn, $M_{i,t}$ is the monthly port loadout capacity for origin port *i*, $\tilde{Q}_{k,t}$ is the simulated random exportable supply for country *k*, and $\widetilde{D}_{j,t}$ is the simulated random import demand for region *j*. The tilde (~) overscript indicates a randomly simulated variable using Monte Carlo.

The first constraint in A1 stipulates that there cannot be any negative trade balance for any trade route; all movements must occur in a single direction. The second constraint dictates that the total monthly volume exported from a specific port must not exceed its loading capacity for that month. The third constraint asserts that the cumulative monthly export volume from all ports in the originating country cannot surpass its available supply. Furthermore, the fourth constraint mandates that exports from all origins to destination region j must meet or exceed the total demand.

The model does not account for internal regional production and logistics for multi-port countries such as the U.S., Ukraine, and Russia. Consequently, the primary optimization logic first allocates shipments to the least-cost port based on the destination. If the port's capacity constraint is binding, any remaining demand must then be met by the next least-cost port, provided it has available capacity. These reallocations continue until the total exports from all ports align with the country's available supply constraint.

In cases where the total exportable supplies exceed the allocated demand, a slack variable, defined as "Rest of World" (ROW), was defined for each origin to hold any supply not allocated to one of the defined destinations. For destinations where total exportable supplies were less than demand, each destination constraint was converted to a soft constraint by adding an origin with an extremely high ($10,000 per metric ton) CIF price and unlimited supply. This would represent a country outside of the five origins modeled and could also represent re-exports through destination regions such as Turkey. In addition to the constraints specified in equation

A1, additional constraints were added to reflect the maximum available port capacities and current policy restrictions on global wheat trade.

The simulated CIF prices from each origin (*i*) to destination (*j*) combination were derived as follows:

$$\tilde{p}_{i,j,t} = \tilde{F}_{i,t} + \tilde{b}_{i,t} + \tilde{o}_{i,j,t}, \quad \text{(A2)}$$

where $\tilde{F}_{i,t}$ is the forecasted nearby futures price for the highest correlated winter wheat futures (KC-CME, CME SRW, or Euronext), $\tilde{b}_{i,t}$ is the forecasted nearby free-on-board (FOB) futures basis, and $\tilde{o}_{i,j,t}$ is the forecasted ocean freight.

Data and Modeling Details:

The model is based on publicly available forecasts from government agencies concerning critical random variables. We utilized long-term forecasts from these sources whenever possible to develop our estimates. To introduce an element of randomness into the annual forecasts, we incorporated a simulated random error term. Given that many of these forecasts are provided on an annual basis, we converted them into monthly estimates by applying historical seasonal indices. Our findings underscore the importance of considering seasonal dynamics when forecasting global trade flows, as they exhibit pronounced seasonal variations.

In instances where historical data was not available, industry expertise was used to generate forecasts through a subject matter expert (SME) method. This approach is convenient, as it allows for the projection of various types of statistical distributions—both subjective (e.g., uniform or triangular) and parametric (e.g., binomial or beta)—over time using autocorrelated random seed values. This method creates more realistic time paths compared to independently simulating each distribution. The subsequent sections will provide a comprehensive discussion of the data, estimation, and forecasting methods employed for each forecasted random variable in the OMCS simulation model.

Available Supply and Demand for Exports:

The initial forecasts for global exports and imports for each trading year were derived from the esteemed USDA Agricultural Projections to 2033, as outlined by the USDA Interagency Agricultural Projections Committee (2024). These projections form a fundamental component of our analytical framework. It is essential to emphasize that the USDA projections do not encompass trade flows. To address this gap, modal values from the USDA projections were utilized in a PERT distribution to generate simulated forecasts for the respective trade years. The minimum and maximum parameters of the PERT distribution were established at plus or minus 10% of the modal value, thereby introducing forecast variability and some degree of randomness into the USDA projections.

Utilizing historical USDA data and supplementary sources, it was assumed that 80% of wheat imports to Mexico comprised hard red winter (HRW), soft red winter (SRW), and white winter (WW) classes of wheat, which are the primary focus of this study. The estimated percentages for other regions are as follows: 85% for North Africa, 80% for Sub-Saharan Africa, 85% for the Middle East, 60% for Asia, 52% for Southeast Asia, 10% for the EU27, 85% for Turkey, and 10% for the U.S. East Coast. Corresponding estimates for exporting nations include 52% for the

United States, 100% for Australia, 100% for Argentina, 95% for the EU, 100% for Ukraine, and 95% for Russia. These percentages were then multiplied by the USDA's total wheat projections to derive the modal values used in the simulation.

To convert the annual import and export forecasts into monthly values, multiplicative seasonal indices were estimated using historical monthly data from 2016/17 through 2023/24 trade years to break the annual export and import forecasts into monthly figures. The monthly export inspection data from the USDA (USDA-AMS, 2024) were utilized for the U.S. export ports (Gulf and PNW), while data for other countries were sourced from the UN Comtrade (United Nations, 2024) online database. The seasonal indices were converted into monthly shares by dividing each monthly index by the total sum of all indices. Monthly forecasts were derived by multiplying the monthly percent shares by the simulated annual forecasts. A blend of historical data, online news sources, and industry contacts was utilized to establish total monthly port export capacity constraints. The maximum monthly export volumes noted in the historical UN Comtrade dataset were applied for Australia, Argentina, and the European Union, yielding 2.766, 3.704, and 5.281 million metric tons (MMT) per month, respectively. For the U.S. Gulf and Pacific Northwest (PNW), historical data from U.S. Wheat Associates was employed to analyze the wheat export volumes from each port. Approximately 30% of the wheat volume exported from the PNW was estimated to be winter wheat varieties, while this figure rose to 70% for the Gulf. This assessment resulted in monthly capacities of 5.7 million metric tons (MMT) for the Gulf and 2.8 MMT for the Pacific Northwest (PNW). Insights from industry contacts indicated that Ukraine's capacities were 1.6 million metric tons (MMT) for Odesa and 1.3 MMT for Constanta. Additionally, recent articles from PortNews (2023) and Reuters (2024a) informed the determination of port capacities for Russian ports, which were set at 4.473 million metric tons (MMT) for the Black Sea, 0.706 MMT for the Sea of Azov, 2.833 MMT for the Baltic, and 0.508 MMT for the Caspian Sea, respectively.

Futures and FOB Basis Values:

Monthly average futures prices from January 2017 to October 2024 were obtained from the Eikon (Refinitiv, 2023a) online database. The nearby futures prices for CME Soft Red Winter (SRW), Kansas City Hard Red Winter (KC HRW), and Euronext Milling wheat were converted into U.S. dollars per metric ton. Port FOB prices were sourced from either Eikon or AgriCensus (Fastmarkets, 2024) on the same monthly schedule as the futures prices. Any missing values were filled using the NIPALs procedure in XLStats (Addinsoft, 2024). The FOB prices were transformed into basis values by deducting the corresponding price of the futures contract that exhibited the highest historical correlation. For forecasting, these monthly basis values were aggregated into calendar year averages. Additionally, additive seasonal indices were derived from the historical FOB basis values to convert the annual forecasts into monthly estimates.

Monthly futures price forecasts from November 2024 to December 2026 were developed by first predicting the CME SRW price through a best-fitting time series model applied to the historical data. The selected model, determined using the BIC fit criterion, was a first-order integrated AR (2) with an exponential transformation. Forecasts for KC and Euronext were generated by analyzing the historical spread between each contract and the CME SRW, employing a distributional best-fit approach. For both series, the most fitting distribution was identified as an extreme value distribution.

The FOB port basis values were projected as calendar-year averages for 2025 and 2026. In light of a structural shift in basis values following the onset of the Russia-Ukraine conflict, only the data from the last three years (2022–2024) were utilized to estimate a straightforward extrapolated distributional forecast using a PERT approximation based on the minimum, average (serving as the mode), and maximum values over these years. The PERT distributions were correlated using a correlation matrix fitted to the entire monthly basis history.

The annual FOB basis forecasts derived from the simulated PERT distributions were then adjusted into monthly forecasts by incorporating the calculated additive seasonal indices. These seasonal indices were themselves simulated using the historical mean and standard deviation of each monthly index value drawn from a normal distribution. Consequently, each monthly FOB basis forecast represented the sum of a random PERT distribution for the annual average and a normal distribution for the additive seasonal adjustment.

Projected monthly Free-on-board (FOB) prices for each export port were calculated by combining the anticipated FOB basis forecast with the forecasted prices from the corresponding wheat futures market. This methodology ensures that the FOB prices reflect both the expected costs associated with transportation and handling at the port, as well as trends in the futures market, providing a comprehensive view of the pricing landscape for wheat exports.

Ocean Rates:

Ocean rate data was collected daily from January 2019 to October 2024, primarily sourced from Eikon, with additional information for a few routes obtained from AgriCensus (FastMarkets). Any missing values were addressed using the NIPALs procedure. The rates were then averaged monthly for 59 key ocean routes, each linking a specific origin to a destination. For routes where ocean rates were not available (i.e., non-standard shipping routes), a fixed value of $1,000 per metric ton was applied.

The model posits that all ocean rates are cointegrated with crude oil prices and the Baltic Dry Index (BDI), informing future projections. Historical crude oil prices for West Texas Intermediate (WTI) were sourced from the FRED online database (Federal Reserve Bank of St. Louis, 2024) within the same monthly timeframe. Daily BDI values were obtained from the Investing.com historical database (Investing.com, 2024) and subsequently converted to monthly averages.

The predictive equations for each ocean rate were obtained by the following regression equation using ordinary least squares (OLS):

$$o_{i,j,t} = \hat{\beta}_{i,j,0} + \hat{\beta}_{i,j,1} \cdot WTI_t + \hat{\beta}_{i,j,2} \cdot BDI_t + \varepsilon_{i,j,t} \quad \text{(A3)}$$

where $o_{i,j,t}$ is the observed ocean rate ($/MT) from origin *i* to destination *j* in month *t*, WTI_t is the average WTI crude oil price, BDI_t is the observed Baltic Dry Index value, $\hat{\beta}_{i,j,n}$ is the estimated regression coefficients, and $\varepsilon_{i,j,t}$ is the regression residual. The time subscript t covers the months from January 2019 through October 2024. To forecast monthly WTI prices from November 2024 to January 2026, a methodology similar to that employed by the U.S. Energy Information Administration (EIA) in their Short-Term Energy Outlook[23] for generating probability-based forecasts was utilized. The CME WTI crude oil futures and option implied volatility forecasts for November 6, 2024, were obtained from ProphetX (Data Transmission Network, 2024). The futures price was used as the mean. At the same time, the implied standard deviation, derived from the option implied volatility, was incorporated into a normalized log-normal distribution to simulate the monthly forecasts from November 2024 through December 2026. In the case of the Baltic Dry Index (BDI), publicly available forecasts are lacking. Consequently, a time series model was fitted to the historical data using the @Risk Bestfit procedure. The best-fitting model, identified by the Bayesian Information Criterion (BIC), was a non-integrated AR (1) model. This model was then used to simulate forecasted values for the period from November 2024 through December 2026. The simulated monthly projections for WTI and BDI were incorporated into the estimated regression equation A3 to simulate the forecasted monthly ocean rates. The residual term in equation A3 was represented by a normal distribution with a mean of 0 and a standard deviation equal to the root mean squared error (RMSE) from the estimated regression equation.

Other Constraints Added to Base Case Simulation:

To align with current international trade policies, four additional constraints have been incorporated into the baseline simulation model. These constraints will be relaxed in the alternative scenarios outlined below to assess their impact on optimal trade patterns. The first constraint pertains to the proposed development of the Baltic and Caspian ports in Russia. To evaluate the implications of these ports becoming operational, the baseline scenario assigns a capacity of zero to both the Baltic and Caspian trade flows. The second constraint addresses the phytosanitary restrictions imposed by the People's Republic of China (PRC) on imports from Ukraine and Argentina. Given that China is categorized within the Asia regional grouping, historical data sourced from the COMTRADE database and the USDA PSD were utilized to estimate the historical average of Chinese imports as a percentage of total imports in the Asia region. A constraint has been established on the direct trade flows from Ukraine and Argentina to Asia, stipulating that such flows must not exceed the percentage-adjusted demand from this region.

[23] https://www.eia.gov/outlooks/steo/report/global_oil.php.

The third constraint is associated with Russia's recent policy of implementing quotas on total exports, which are generally applicable from February to June each year. These quotas have historically varied between 8.0 and 18.5 million metric tons (MMT), with an average of 13.7 MMT for the five months of the year. To incorporate the effects of this quota, the annual (five-month) quota will be simulated using a triangular distribution based on historical observations to determine the minimum, mean (as the modal parameter), and maximum values. The total quota will then be evenly divided across the five months. Subsequently, the maximum available supply will be set to the lesser of either the actual simulated value or the simulated quota amount.

The fourth constraint aims to replicate Russia's current policy of not exporting to countries deemed “unfriendly”. To create this constraint, the historical COMTRADE data was queried to determine the average percentage of imports for each region received by countries that Russia has deemed “friendly” or “neutral” (based on various news sources). The percentages assigned for each region were 100% for North Africa, 100% for Sub-Saharan Africa, 100% for the Middle East, 58% for Asia, 99% for SE Asia, 5% for the EU, 100% for Mexico, 100% for South America, 100% for Turkey, and 0% for the United States. Total Russian trade flows to each of these regions were constrained not to exceed the simulated regional demand multiplied by the “friendly” percentage.

Alternative Scenarios:

To assess the sensitivity of the model results to the aforementioned constraints and to evaluate several proposed policies, we conducted a series of seven alternative model scenarios in addition to the baseline scenario. Each alternative scenario represented a distinct replicated version of the baseline model, incorporating the specific changes. To ensure comparability and eliminate variability introduced by random seed selection, the Monte Carlo random seed was consistently set to a fixed value across all simulations, including the baseline. The simulation results from each alternative scenario model are then compared to the baseline model to assess the impact of the alternative scenario on trade flows.

Alt 1A: Russian Baltic Sea Ports Operate at Reduced Capacity

In this scenario, the zero-capacity constraint on the Baltic port is removed, and it is allowed to operate at a 0.5 MMT per month capacity, reflecting that the port cannot operate at full capacity due to limitations on rail deliveries to the facilities.

Alt 1B: Russian Baltic Sea Ports Operate at Full Capacity

In this scenario, the Baltic port's zero-capacity constraint is removed, and it operates at its full 2.833 million metric tons (MMT) monthly capacity.

Alt 1C: Russian Baltic and Caspian Sea Ports Operate at Full Capacity

In this scenario, the zero-capacity constraint is removed from both the Baltic and Caspian Sea ports, allowing them to operate at their full capacities (2.833 and 0.508 million metric tons, respectively).

Alt 2: China Phytosanitary Constraints on Ukraine and Argentina Removed

In this scenario, the Chinese percent adjustment no longer restricts trade flows from Ukraine and Argentina to the Asia region.

Alt 3: Russian Export Quotas Completely Removed

In this scenario, the Russian export quota constraint on the total available exports for February through June of each year is effectively removed.

Alt 4: Russia Removes "Unfriendly" Country Restrictions

In this scenario, all of the regional "friendly" country percentages are set to 100%.

Alt 5: Russia Sets Minimum FOB Prices to $250 per Metric Ton

In this scenario, the simulated FOB prices for Russian ports are set to the minimum of the simulated price or $250 per metric ton.

Alt 6: Russian Exports Grow by 50% by the Year 2030

In this scenario, the mean annual exportable supply from Russia is increased by 10% per year for 2025 and 2026 to replicate the even growth rate of 50% over the next five years. Note that the baseline assumes a much lower annual growth rate.

Alt 7: Mexico Severely Constrains Ukraine Wheat Imports Due to Quality Restrictions

In this scenario, the CIF cost for wheat from Ukraine to Mexico is set at $1,000 per mt to severely restrict or eliminate the flow of Ukrainian wheat to Mexico.

Appendix B: Additional Empirical Results

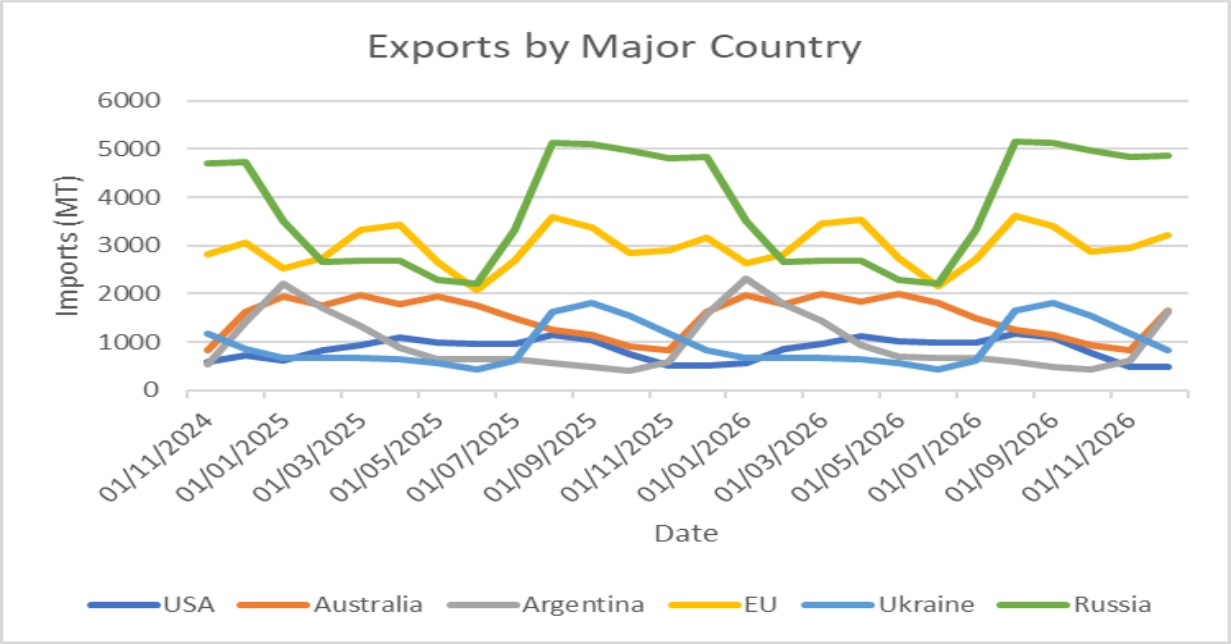

Figure B1. Seasonal Exports (Derived) for 2024-2026, by Major Exporting Country

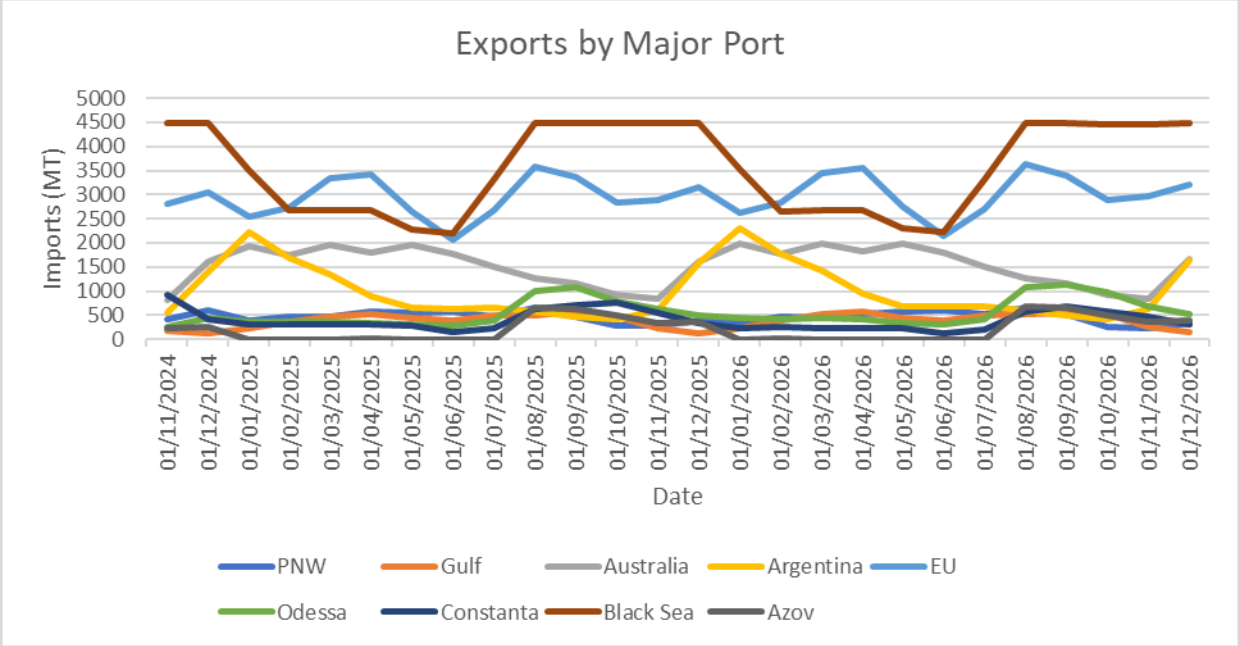

Figure B2. Seasonal Exports (Derived) for 2024-2026 by Major Exporting Country

Table B1. Baltic Ports Open at 500K per Month: Change in Base Case Flows and Market Shares

Change from Baseline

United States

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	-76	-81	0	-279	-21	-3	0	-41	-52	0	553	0
2026	-86	-68	0	-299	-41	-2	0	-21	-16	0	533	0
Percent of Total												
2025	-0.7%	-0.7%	0.0%	-2.4%	-0.2%	0.0%	0.0%	-0.4%	-0.5%	0.0%	4.8%	0.0%
2026	-0.7%	-0.6%	0.0%	-2.5%	-0.3%	0.0%	0.0%	-0.2%	-0.1%	0.0%	4.5%	0.0%

Australia

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	0	0	1	-35	-94	0	0	0	20	0	108	0
2026	0	0	0	-13	-117	0	0	0	16	0	114	0
Percent of Total												
2025	0.0%	0.0%	0.0%	-0.2%	-0.5%	0.0%	0.0%	0.0%	0.1%	0.0%	0.6%	0.0%
2026	0.0%	0.0%	0.0%	-0.1%	-0.6%	0.0%	0.0%	0.0%	0.1%	0.0%	0.6%	0.0%

Argentina

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	-1	-58	0	-13	6	1	15	0	-31	0	84	2
2026	-9	-31	0	-21	15	2	16	0	-45	0	74	2
Percent of Total												
2025	0.0%	-0.5%	0.0%	-0.1%	0.1%	0.0%	0.1%	0.0%	-0.3%	0.0%	0.7%	0.0%
2026	-0.1%	-0.2%	0.0%	-0.2%	0.1%	0.0%	0.1%	0.0%	-0.4%	0.0%	0.6%	0.0%

EU

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	407	-910	0	453	0	1	0	-1	0	0	50	0
2026	442	-989	0	507	0	2	0	2	0	0	35	0
Percent of Total												
2025	1.2%	-2.6%	0.0%	1.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%
2026	1.2%	-2.7%	0.0%	1.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%

Ukraine

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	-23	-113	0	-99	0	-1	0	-2	97	119	24	0
2026	-72	-63	0	-108	-4	-5	0	-39	89	140	61	0
Percent of Total												
2025	-0.2%	-1.0%	0.0%	-0.9%	0.0%	0.0%	0.0%	0.0%	0.9%	1.0%	0.2%	0.0%
2026	-0.6%	-0.6%	0.0%	-1.0%	0.0%	0.0%	0.0%	-0.3%	0.8%	1.2%	0.5%	0.0%

Russia

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	-269	1,172	-46	0	109	4	0	42	0	-119	-894	0
2026	-263	1,166	-27	0	145	4	0	58	0	-140	-944	0
Percent of Total												
2025	-0.6%	2.6%	-0.1%	0.0%	0.2%	0.0%	0.0%	0.1%	0.0%	-0.3%	-1.9%	0.0%
2026	-0.6%	2.5%	-0.1%	0.0%	0.3%	0.0%	0.0%	0.1%	0.0%	-0.3%	-2.1%	0.0%

Table B2. Baltic and Caspian Ports Fully Open: Change in Base Case Flows and Market Shares

Change from Baseline

United States

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	124	109	18	-840	-85	0	0	12	-248	0	909	0
2026	77	173	4	-826	-131	0	0	18	-190	0	875	0
Percent of Total												
2025	1.1%	0.9%	0.2%	-7.3%	-0.7%	0.0%	0.0%	0.1%	-2.2%	0.0%	7.9%	0.0%
2026	0.6%	1.5%	0.0%	-7.0%	-1.1%	0.0%	0.0%	0.2%	-1.6%	0.0%	7.4%	0.0%

Australia

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	41	10	79	898	-1,370	0	0	0	42	0	300	0
2026	27	21	71	1,006	-1,417	0	0	0	46	0	246	0
Percent of Total												
2025	0.2%	0.1%	0.4%	4.8%	-7.4%	0.0%	0.0%	0.0%	0.2%	0.0%	1.6%	0.0%
2026	0.1%	0.1%	0.4%	5.3%	-7.5%	0.0%	0.0%	0.0%	0.2%	0.0%	1.3%	0.0%

Argentina

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	58	-33	44	-168	-7	1	12	0	-32	0	126	1
2026	-1	20	47	-141	4	3	14	0	-49	0	106	3
Percent of Total												
2025	0.5%	-0.3%	0.4%	-1.4%	-0.1%	0.0%	0.1%	0.0%	-0.3%	0.0%	1.0%	0.0%
2026	0.0%	0.2%	0.4%	-1.1%	0.0%	0.0%	0.1%	0.0%	-0.4%	0.0%	0.8%	0.0%

EU

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	400	-1,680	29	1,068	0	1	0	32	0	0	150	0
2026	420	-1,639	70	998	0	3	0	37	0	0	110	0
Percent of Total												
2025	1.1%	-4.8%	0.1%	3.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.4%	0.0%
2026	1.2%	-4.5%	0.2%	2.8%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.3%	0.0%

Ukraine

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	-37	-200	0	-208	0	-5	0	-18	162	255	51	0
2026	31	-263	0	-240	-10	-8	0	-66	147	335	74	0
Percent of Total												
2025	-0.3%	-1.8%	0.0%	-1.8%	0.0%	0.0%	0.0%	-0.2%	1.4%	2.3%	0.5%	0.0%
2026	0.3%	-2.3%	0.0%	-2.1%	-0.1%	-0.1%	0.0%	-0.6%	1.3%	3.0%	0.7%	0.0%

Russia

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	-570	1,753	-753	-3	1,472	4	0	-26	0	-264	-1,612	0
2026	-550	1,694	-845	0	1,557	4	0	13	0	-335	-1,537	0
Percent of Total												
2025	-1.2%	3.8%	-1.6%	0.0%	3.2%	0.0%	0.0%	-0.1%	0.0%	-0.6%	-3.5%	0.0%
2026	-1.2%	3.7%	-1.8%	0.0%	3.4%	0.0%	0.0%	0.0%	0.0%	-0.7%	-3.3%	0.0%

Table B3. China Phyto Restrictions Lifted: Change in Base Case Flows and Market Shares

Change from Baseline

United States

Year	Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	-12	12	0	0	0	0	0	0	0	0	0	0
2026	18	-18	0	-9	9	0	0	0	0	0	0	0
Percent of Total												
2025	-0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2026	0.2%	-0.2%	0.0%	-0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Australia

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	0	0	0	0	0	0	0	0	0	0	0	0
2026	0	0	0	9	-9	0	0	0	0	0	0	0
Percent of Total												
2025	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2026	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Argentina

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	85	-85	0	0	0	0	0	0	0	0	0	0
2026	-52	52	0	0	0	0	0	0	0	0	0	0
Percent of Total												
2025	0.7%	-0.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2026	-0.4%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

EU

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	-68	68	0	0	0	0	0	0	0	0	0	0
2026	40	-40	0	0	0	0	0	0	0	0	0	0
Percent of Total												
2025	-0.2%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2026	0.1%	-0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Ukraine

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	-11	11	0	0	0	0	0	0	0	0	0	0
2026	-3	3	0	0	0	0	0	0	0	0	0	0
Percent of Total												
2025	0.1%	-0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2026	0.3%	-0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Russia

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	5	-5	0	0	0	0	0	0	0	0	0	0
2026	-5	5	0	0	0	0	0	0	0	0	0	0
Percent of Total												
2025	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2026	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Table B4. Unrestricted Russia Export Quota: Change in Base Case Flows and Market Shares

Change from Baseline

United States

Year	Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	-327	-256	0	557	25	-4	0	-104	61	0	47	0
2026	-289	-151	0	386	26	-3	0	-101	33	0	99	0
Percent of Total												
2025	-2.8%	-2.2%	0.0%	4.8%	0.2%	0.0%	0.0%	-0.9%	0.5%	0.0%	0.4%	0.0%
2026	-2.4%	-1.3%	0.0%	3.3%	0.2%	0.0%	0.0%	-0.8%	0.3%	0.0%	0.8%	0.0%

Australia

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	-4	0	-1	808	-806	0	0	0	1	0	2	0
2026	-8	0	-10	966	-957	0	0	0	2	0	7	0
Percent of Total												
2025	0.0%	0.0%	0.0%	4.4%	-4.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2026	0.0%	0.0%	-0.1%	5.1%	-5.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Argentina

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	-17	-63	-35	71	-7	1	12	0	-2	0	41	0
2026	-61	-61	-55	95	-5	2	16	0	-3	0	76	2
Percent of Total												
2025	-0.1%	-0.5%	-0.3%	0.6%	-0.1%	0.0%	0.1%	0.0%	0.0%	0.0%	0.3%	0.0%
2026	-0.5%	-0.5%	-0.4%	0.7%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.6%	0.0%

EU

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	-131	157	-33	9	0	1	0	-2	0	0	0	0
2026	-94	150	-66	9	0	2	0	-4	0	0	5	0
Percent of Total												
2025	-0.4%	0.4%	-0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2026	-0.3%	0.4%	-0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Ukraine

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	23	-35	0	37	0	2	0	24	0	-51	0	0
2026	25	-46	0	70	0	4	0	35	2	-89	0	0
Percent of Total												
2025	0.2%	-0.3%	0.0%	0.3%	0.0%	0.0%	0.0%	0.2%	0.0%	-0.5%	0.0%	0.0%
2026	0.2%	-0.4%	0.0%	0.6%	0.0%	0.0%	0.0%	0.3%	0.0%	-0.8%	0.0%	0.0%

Russia

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	662	303	440	0	804	0	0	87	0	51	0	2,348
2026	646	187	470	0	949	0	0	74	0	89	0	2,415
Percent of Total												
2025	1.0%	0.2%	-1.3%	0.0%	0.9%	0.0%	0.0%	0.1%	0.0%	-0.8%	-0.2%	0.0%
2026	1.0%	-0.1%	-1.3%	0.0%	1.2%	0.0%	0.0%	0.1%	0.0%	-0.7%	-0.2%	0.0%

Table B5. Russia Removes Unfriendly Country Restrictions: Change in Base Case Flows and Market Shares

Change from Baseline

United States

Year	Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	2	2	0	-7	-3	0	0	1	4	0	1	0
2026	2	2	0	-2	-5	0	0	1	1	0	0	0
Percent of Total												
2025	0.0%	0.0%	0.0%	-0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2026	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Australia

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	0	0	0	45	-45	0	0	0	0	0	0	0
2026	0	0	0	39	-40	0	0	0	0	0	0	0
Percent of Total												
2025	0.0%	0.0%	0.0%	0.2%	-0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2026	0.0%	0.0%	0.0%	0.2%	-0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Argentina

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	1	3	0	0	-4	0	0	0	0	0	0	0
2026	2	2	0	0	-4	0	0	0	0	0	0	0
Percent of Total												
2025	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2026	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

EU

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	24	13	0	-36	0	0	0	0	0	0	0	0
2026	17	18	0	-35	0	0	0	0	0	0	0	0
Percent of Total												
2025	0.1%	0.0%	0.0%	-0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2026	0.0%	0.0%	0.0%	-0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Ukraine

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	-4	10	0	-2	-1	0	0	1	-5	1	0	0
2026	-2	5	0	-2	-1	0	0	1	-2	1	0	0
Percent of Total												
2025	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2026	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Russia

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	-23	-27	0	0	54	0	0	-2	0	-1	-1	0
2026	-19	-27	0	0	50	0	0	-2	0	-1	-1	0
Percent of Total												
2025	0.0%	-0.1%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2026	0.0%	-0.1%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Table B6. Russia Imposes Minimum Price of $250/mt: Change in Base Case Flows and Market Shares

Change from Baseline

United States

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	-346	-316	0	-266	7	176	0	1,279	27	0	-562	0
2026	-502	-250	0	-341	10	156	0	1,456	-62	0	-467	0
Percent of Total												
2025	-3.0%	-2.7%	0.0%	-2.3%	0.1%	1.5%	0.0%	11.1%	0.2%	0.0%	-4.9%	0.0%
2026	-4.2%	-2.1%	0.0%	-2.9%	0.1%	1.3%	0.0%	12.3%	-0.5%	0.0%	-3.9%	0.0%

Australia

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	-3	0	0	-549	608	0	0	0	-13	0	-43	0
2026	-7	1	1	-528	565	0	0	0	-5	0	-28	0
Percent of Total												
2025	0.0%	0.0%	0.0%	-3.0%	3.3%	0.0%	0.0%	0.0%	-0.1%	0.0%	-0.2%	0.0%
2026	0.0%	0.0%	0.0%	-2.8%	3.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.1%	0.0%

Argentina

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	-12	16	0	38	25	127	0	0	1	0	-143	52
2026	62	2	-15	-12	91	112	-1	0	6	0	-212	33
Percent of Total												
2025	-0.1%	0.1%	0.0%	0.3%	0.2%	1.0%	0.0%	0.0%	-0.3%	0.0%	-1.2%	0.0%
2026	0.5%	0.0%	-0.1%	-0.1%	0.7%	0.9%	0.0%	0.0%	-0.1%	0.0%	-1.6%	0.0%

EU

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	371	121	-7	-603	0	127	0	12	0	0	-22	0
2026	340	133	-15	-584	0	112	0	19	0	0	-5	0
Percent of Total												
2025	1.1%	0.3%	0.0%	-1.7%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%	-0.1%	0.0%
2026	0.9%	0.4%	0.0%	-1.6%	0.0%	0.3%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%

Ukraine

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	477	327	0	1,394	24	-390	0	-2,171	-66	444	-40	0
2026	291	324	0	1,515	26	-357	0	-2,339	-18	589	-30	0
Percent of Total												
2025	4.2%	2.9%	0.0%	12.3%	0.2%	-3.4%	0.0%	-19.2%	-0.6%	3.9%	-0.4%	0.0%
2026	2.6%	2.9%	0.0%	13.4%	0.2%	-3.2%	0.0%	-20.7%	-0.2%	5.2%	-0.3%	0.0%

Russia

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	-449	-139	25	-3	-664	0	0	866	0	-444	810	0
2026	-185	-183	47	0	-692	0	0	860	0	-589	742	0
Percent of Total												
2025	-1.0%	-0.3%	0.1%	0.0%	-1.4%	0.0%	0.0%	1.9%	0.0%	-1.0%	1.8%	0.0%
2026	-0.4%	-0.4%	0.1%	0.0%	-1.5%	0.0%	0.0%	1.9%	0.0%	-1.3%	1.6%	0.0%

Table B7. Russia Exports Grow by 10%/Year: Change in Base Case Flows and Market Shares

Change from Baseline

United States

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	-16	-23	0	-209	-14	-1	0	-53	-19	0	336	0
2026	-126	-92	0	-183	-50	-3	0	-109	3	0	561	0
Percent of Total												
2025	-0.1%	-0.2%	0.0%	-1.8%	-0.1%	0.0%	0.0%	-0.5%	-0.2%	0.0%	2.9%	0.0%
2026	-1.1%	-0.8%	0.0%	-1.5%	-0.4%	0.0%	0.0%	-0.9%	0.0%	0.0%	4.7%	0.0%

Australia

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	0	0	0	20	-166	0	0	0	37	0	109	0
2026	0	-3	0	74	-417	0	0	0	86	0	260	0
Percent of Total												
2025	0.0%	0.0%	0.0%	0.1%	-0.9%	0.0%	0.0%	0.0%	0.2%	0.0%	0.6%	0.0%
2026	0.0%	0.0%	0.0%	0.4%	-2.2%	0.0%	0.0%	0.0%	0.5%	0.0%	1.4%	0.0%

Argentina

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	0	-6	0	-15	-1	2	20	0	-28	0	32	2
2026	-117	-84	0	-55	-32	3	22	0	-45	0	313	4
Percent of Total												
2025	0.0%	-0.1%	0.0%	-0.1%	0.0%	0.0%	0.2%	0.0%	-0.2%	0.0%	0.3%	0.0%
2026	-0.9%	-0.6%	0.0%	-0.4%	-0.2%	0.0%	0.2%	0.0%	-0.4%	0.0%	2.4%	0.0%

EU

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	-84	-190	0	270	0	2	0	-2	0	0	5	0
2026	-314	-116	-1	405	0	3	0	-4	0	0	27	0
Percent of Total												
2025	-0.2%	-0.5%	0.0%	0.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2026	-0.9%	-0.3%	0.0%	1.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%

Ukraine

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	-10	-63	0	37	-1	0	0	2	84	-55	6	0
2026	30	-121	0	51	-2	3	0	-1	94	-57	2	0
Percent of Total												
2025	-0.1%	-0.6%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.7%	-0.5%	0.1%	0.0%
2026	0.3%	-1.1%	0.0%	0.5%	0.0%	0.0%	0.0%	0.0%	0.8%	-0.5%	0.0%	0.0%

Russia

Year	North Africa - Egypt	Sub-Saharan Africa	Middle East (ex Turkey)	Asia (ex SE Asia)	SE Asia	European Union	US (East Coast)	Mexico	South America	Turkey	Rest of World	Total
Total Exports (000 MT)												
2025	110	282	0	0	182	0	0	53	0	55	2,063	2,745
2026	563	437	15	0	501	0	0	115	0	57	4,957	6,645
Percent of Total												
2025	-0.2%	0.1%	-2.5%	0.0%	-0.5%	0.0%	0.0%	0.0%	0.0%	-0.9%	4.0%	0.0%
2026	0.2%	-0.3%	-5.7%	0.0%	-1.1%	0.0%	0.0%	0.1%	0.0%	-2.2%	9.0%	0.0%